THE

Practical Teacher

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'Knowledge is proud that he has learned so much,
Wisdom is humble that he knows no more.'—COWPER.

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Hygiene.

BY ALFRED CARPENTER, M.D., M.R.C.P. (LOND.), C.S.S., CAMB.

METEOROLOGICAL CONDITIONS—(*continued*).

Rainfall, Humidity, Fogs.—Those who are anxious to get a thorough knowledge upon these subjects must consult Dr. Angus Smith's great work upon 'Air and Rain,' which, with Mr. G. J. Symond's 'British Rainfall Tables,' will give a perfect insight into these important points. I can only give outlines.

The rainfall in a given district is estimated by means of a rain gauge, which should be self-recording, if perfect accuracy is to be obtained. As Mr. Symonds remarks, self-recording are something in advance of self-registering gauges. That which is kept at Kew consists of a funnel of cast-iron enamelled inside with a superficial area of 100 square inches; the rain falling upon this area is conveyed into a copper bottle supported on a stand floating in a cistern of mercury, in which it gradually sinks as the volume of water increases, when a fixed quantity of water has fallen it reaches a syphon, which is set in action, and the water is drawn off into another vessel, which records the quantity, the stand and bottle floating back to its original position, other machinery is set at work and a perfect record kept as to the quantity of rainfall in a given time. The quantity of water has a relation to the area of the funnel, and by a simple calculation the amount is arrived at. Rain gauges are, however, more generally approximate than accurate, not generally self-registering even; a funnel having an ascertained superficial area, which collects the rain and conveys it into the bottle which has been marked so that the quantity of rain which has fallen in the preceding twenty-four hours may be read off and registered at a given time every day by the observer himself. Great care must be taken in fixing upon a site for the gauge. It must not be placed upon a slope, or near to a large building, or under a hill, but in the centre of a level, open piece of ground, as far as possible away from clumps of trees. The level of the funnel must be perfect, and so fixed as not to be influenced by a strong wind. It should be placed not more than one or at most two feet from the ground, and the height of the site above the sea-level must be correctly known. The condition of the funnel must be carefully noted, and if it shows signs of corrosion it should be changed, because a rough or corroded surface retains water which evaporates instead of finding its way into the bottle. The time of reading should be scrupulously kept to the same minute every day—nine a.m. is the most usual time. Mr. Symonds insists upon the necessity for the perfect accuracy upon the part of the recorder, especially in the estimation of small quantities; any one determining to become an observer should study most carefully the suggestions which Mr. Symonds has drawn up. The estimation of snow is a difficulty which can only be overcome by careful observation; melting the snow which may be caught in the gauge by a measured quantity of hot water, or by using a long funnel into which the snow may gravitate, and so avoid the risk of its being blown away before it melts.

The Amount of Rainfall.—Various in different localities. In Croydon it averages twenty-five inches in the year. The mean for all England is about thirty-two inches, diminishing towards the east coast, increasing towards the high land on the west and in the neighbourhood of the Atlantic Ocean. In some parts of the country there are curious differences from this general result; thus, whilst the rainfall is very high in Exeter and Plymouth, it is very low on the neighbouring coast from some local causes which are not clearly explained; so also at Cockermouth it is low, whilst within thirty-five miles of that place we have the highest records of any in England, for in some parts of the Lake District it rises to eighty-five inches, or even more. Every inch of rain which falls upon an acre of land gives 22,620 gallons of water; this affords rather more than half-a-million gallons per acre as the rainfall, if the average is twenty-three inches in the year. This calculation has an importact bearing upon the water supply of a given district. The area of a given collecting ground being known, the quantity available for supply will be affected by various contingencies, which increase or decrease according to the position of the reservoir. If it be a mountain lake in a rocky district, much of the whole

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will find its way into the basin. If it be from deep wells in the chalk areas, a great deduction must be made for the amount for evaporation from the surface of the earth in dry weather. It is found, on the average, that about six inches only of the rainfall upon the chalk downs can be depended upon as available for water supply. Mr. J. Lucas, of the Geological Survey, has worked out some of these points in his most valuable work upon 'Horizontal Wells in the Chalk,' a work which is being followed up by Mr. B. Latham, and whose observations, if based upon correct principles, will be of great service in fixing upon areas for the water supply of great towns.

It may be useful to know that to bring cubic inches into gallons, it is only necessary to multiply by 40 and divide by 11090, since 272·274 cubic inches make a gallon.

The humidity of a district is closely associated with the rainfall, though not entirely dependent upon it. The quantity of watery vapour which can be retained by the air varies with the temperature. It is held in a gaseous and perfectly invisible form, under certain circumstances, but when those are altered the water may become visible as fog, or mist, or descend as rain; the principal change being a fall in the temperature of the atmosphere itself, from contact with colder earth, or being mingled with streams of colder air from other regions. Air at 30° F. retains about two grains of water in an invisible form per cubic foot, rising to five grains at 56°, ten grains at 77°, and twenty grains at 100° F. This humidity of the air is closely connected with the *dew-point*, meaning the point of saturation. Degrees of humidity mean the percentages of saturation, the capacity for saturation rising in quantity with the rise of temperature. The dew-point can be ascertained by means of an instrument called the *Hygrometer*. This is a double thermometer.

The dry and wet bulb thermometer is that which is most usual in practice. Any two thermometers will do, provided they are perfectly in accord, the bulbs must project below the scale, one being covered with muslin, the other being free. The muslin which must be very clean and free from starch must be kept wet, or if the temperature be below freezing-point, frozen; if it rise whilst under observation above freezing-point, the muslin must be thawed before a record is taken. To attain this end, the muslin must have a few threads attached to it, which dip into a vessel containing distilled water, so that by means of capillary attraction the muslin is always moist.

The difference of the temperature between the two thermometers gives the difference between that at which dew becomes manifest, and the actual temperature of the air; it indicates the amount of moisture which the air would take up before it was perfectly saturated. Thus, if the wet bulb stood at 49° F. whilst the temperature of the air was really 70° F. as shown by the dry bulb, it would tell us that the amount of moisture in the air was four grains in the cubic foot of air, whilst the amount really required to produce saturation would have to be doubled, viz., eight grains, that being the quantity required to produce perfect saturation at the temperature of 70°. The temperature at which dew would become deposited is close upon 49°, and this would be the dew-point under these circumstances. The observation also tells us the amount of vapour in each cubic foot of air, the additional quantity required to saturate it, and the relative humidity. We also learn the elastic force of vapour, or the amount of barometric pressure which is due to the vapour present in the atmosphere, and it gives us some idea as to the approach or otherwise of wet weather.

Various tables have been drawn up by Mr. Glaisher and others for determining these points by which intricate calculations are obviated, and quotients more easily arrived at.

The quantity of moisture in the air determines the agreeableness of a given climate; an air which is too dry is very irritating; a cold dry air is, however, more endurable than the opposite; 70 or 80 per cent. of saturation is best for the ordinary temperatures, but this varies very much according to the temperament and the constitution of the individual.

The deposit of dew upon the grass in the night is closely connected with the loss of heat from the surface of the earth by radiation. If the latter is interfered with by clouds, there will be no dew deposited, because the earth is not chilled to a point below the dew-point of the atmosphere.

Fogs and Mist.—These differ from dew, inasmuch as the latter is caused by terrestrial radiation and the absence of clouds or other screens. Fogs are due to difference in quantity of vapour in the air itself, they are made manifest by being mixed with other air which is at a lower temperature, the warmer air containing the larger amount of vapour. The plains and valleys in the near neighbourhood of higher ground are sometimes seen as the shades of evening come on to be filled with mist, whilst the higher ground is free from the evidence of it. The air in the higher region is being gradually chilled by radiation; as the evening advances, the cold air descends to the earth, and then affords the evidence of a larger quantity of moisture in the strata of the atmosphere which are nearer to the ground. As the air continues to get colder, the fog seems to rise higher and higher, until the dew-point of temperature is reached in the whole of the visible regions. Sea-fogs sometimes develop very suddenly, a cold blast of air falling from above from changes in pressure and condensing the vapour in the atmosphere of immense regions in a very short time, especially at sea. They are always accompanied by a feeling of cold, because a moist atmosphere conveys away heat from the body by conduction, in a much more rapid manner than dry air does.

Ozone.—Much influence upon health is supposed to be produced by ozone. Its absence is attended by health disturbances, and such diseases as erysipelas, and others having a low type. Its presence is supposed to assist in producing health and giving strength. Suffice it to say that fresh air is invigorating according as it contains ozone or not. Ozone is always absent in foul air and in air that has been already breathed by living creatures. It is destroyed by animal life, it is set free by vegetation. It is produced by electric action, and by motion of every kind, especially by the wind. It is nearly always found on the surface of the sea, and is always absent in the centres of large cities, unless the weather is very stormy. It may be found in the air to the windward side of a city whilst it is absent to the leeward side of the same city at the same time, showing that it has been used up by the oxidising agencies, which are always going on among a dense population. Its determination was thought

to be an important factor in the healthiness or unhealthiness of a given district, but suspicion has been thrown upon these observations in consequence of the contrary character of the results. Papers are prepared and sold for the purpose of making observations. They have been soaked in a composition of iodide of potassium and starch. When they are exposed to the air, the quantity of ozone is thought to be indicated by the change of colour which takes place in the paper after an exposure for a definite time. The colour is compared with a fixed scale, and the quantity of ozone estimated according to the intensity of colour produced. The change of colour is produced by the action of the ozone oxidising the potassium and setting free the iodine, which produces a colour more or less blue according to the rapidity of the oxidizing process; free iodine giving this result in the presence of starch. Ozone is an allotropic form of oxygen with very powerful oxidizing properties, but the iodine test is not a reliable one, because other agents besides ozone may act upon the paper, such as nitrous acid: and it is not possible for the paper to be exposed continuously under the same conditions as to temperature, moisture, movement of the air, and quantity of sun-light, all of which act more or less in modifying the result. It may, however, be taken for certain that the presence of ozone and its accompaniments are advantageous to health, whilst its absence is attended by conditions which are correspondingly injurious. Further information as to its properties may be obtained from Dr. Cornelius Fox's standard work, 'Ozone and Antozone: its when, its where, why, and how.'

The meteorological observations which are requisite to be made by a general observer are those which refer to temperature, which should be the highest in both sun and shade, the lowest on the grass, as well as a few feet from the ground. These should be taken at the same time every day. The *dew-point* should be registered, the rainfall calculated, the direction of the wind observed, the approximate time at which it changed should be noted. The amount of sunshine is sometimes calculated by means of a delicate process which is set in action by direct light.

Some observers take note of the character of *Cloud*. This is done by a system of numbers, in which 10 indicates a sky perfectly obscured and 0 a cloudless sky. The modifications of clouds are called by various names, of which the principal are: *The Cirrus*, which are thin filaments; *The Cumulus*, or conical heaps like mountains; and *The Stratus*, a horizontal sheet, such as oftens forms at sunset. There are various combinations of these forms which will be recognised by practice, and are named accordingly—the Cirro-cumulus, Cirro-stratus, the Cumulo-cirro-stratus (or, more shortly, the Nimbus or rain-cloud), and the Cumulo-stratus.

(To be continued.)

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How to Teach History.

BY ISABELLA LANDALE.

(Continued from page 253.)

Change of Method for Advanced Pupils.

Having indicated the method of teaching pupils till they reach the age of eleven or twelve, we would propose some change in the method. Instead of a text-book giving an ample and interesting account of the events treated, we would now recommend one of a more meagre description, giving little more than a brief and clear outline of the more important events. A voluminous work, however interesting, is now to be avoided, because it does the work which should be done by the pupils. Instead of the first impression being made by the master as we described, he will now simply give out the lesson by indicating a certain passage in the new textbook, leaving the pupils themselves to find out the particulars and amplifications of the events which are merely named in the textbook. The information thus acquired is either to be given in in writing, or to be elicited by questioning in the class, or a combination of both these methods might be employed. Historical essays would also be valuable as a means of expressing the information obtained. If this plan were to be carried out, however, it would be necessary for the pupils to have access to a good reference library, as otherwise the children of the wealthy would have an unfair advantage. This would be troublesome at first, but would be a mere matter of arrangement, either by books of reference belonging to the school, or by admission of the children to public libraries. It would farther be necessary for the teacher to supply a list of the works to which the pupils might refer, as a precaution against their applying to untrustworthy sources of information, or being led to the perusal of works otherwise unfit to be read by the young.

It has always been found that the knowledge we discover for ourselves is more deeply impressed on our minds than what we are told by others; and the freshness and life which this method would impart to a class would amply repay any trouble it gave the teacher in organising it. This practice would be in the same spirit, and might have as much effect in encouraging a taste for private study as the custom of the 'Studientag' at Schulpforta.*

It will doubtless be objected that such a method of study, however desirable in theory, is utterly impossible in practice. We frankly confess the force of the objection, which is almost insurmountable, at least with regard to common schools. But nevertheless, it may do no harm to suggest the idea, in the hope that a rational mode of working it might be discovered by the practical wisdom and ingenuity of others, for the solid benefits to be derived from such a mode of study are so great that it would be a pity to throw the scheme lightly aside. Fifty years ago such a project would have been looked upon as utterly wild; but so would many of the school methods in daily use at the present time, involving, as they do, great expense and trouble in their preliminary organisation. The whole *impedimenta* of the Kindergarten system, and the apparatus necessary for a course of object lessons, are now provided in many places as a matter of course, although at first they would very likely seem as impracticable as the working details of the method just suggested. But here we have to face not only the impossibility of procuring books of reference for hundreds of pupils, but the still greater difficulty of finding time for their researches. Every one accustomed to such work knows how great is the consumption of time in consulting books of reference, and children could not spare so much from their other lessons. But to save

* For which see Matthew Arnold's 'Higher Schools and Universities in Germany.'

time we would suggest that the teacher should at first indicate, not only the books to be consulted, but the parts of the volume where the desired information is to be found, and he should continue to do this till the pupils acquire sufficient skill to render such aid superfluous.

Suppose a class of twenty boys, divided into four groups of five boys each. On Monday the teacher gives them the outline paragraph to be amplified, and allows a week for the accomplishment of the task. To each five boys one book of reference is given, and each boy in turn is allowed to take it home with him for a night. On Saturday morning it is taken back to the school, where it (and the other three works of reference) lie for the use of any enthusiastic pupils who wish to consult them there. The next Monday each boy brings his amplification in writing; these are afterwards looked over by the teacher, who gives marks according to the order of merit. In the meantime, a paper from one of the four groups is read aloud; any errors it contains are pointed out and corrected by the boys, or, failing them, by the teacher. Any interesting facts not mentioned may be added by the boys of the same group. Then a paper is taken from the next group and treated in the same way, and so on till all four groups are represented. The school-work of the class during the week is thus the criticism and amplification of these papers, while the home work consists in preparing the paper for the next week. Great variety of incident and treatment is thus obtained. The above is given as a specimen of how the matter might be organised in a small school, but, as far as we can see, the only way in which such a system could be applied to large numbers of boys would be by forming a class within a class, and by making admission to this select twenty the reward of distinguished merit.

Such a method would also pave the way for the pupil carrying on his historical studies by himself after he leaves school—a habit which should be expressly encouraged by the teacher, and for which provision ought to be made, for the historical knowledge gained at school is but a stepping-stone to what ought to follow, especially as the whole field of modern history has to be entered upon after the pupils leave school. A master who has brought his pupils successfully through such a course as we have sketched will doubtless have gained the confidence and affection of his pupils, and must have considerable influence over them. It would be using that influence in a most desirable way if he could induce his pupils on leaving his care to undertake a course of historical reading for themselves; and his advice as to the general scope of their reading and the books to use, would be invaluable to them. For this purpose he might suggest the formation of an 'old boys' club,' which would no doubt be taken advantage of by the more intelligent and studious of the pupils. It would be an immense advantage to boys whose school-days are not to be followed by a university career, and also to girls; for, if the study is given up after leaving school, it is difficult to resume it in after life. The objects to be kept in view are those indicated in the second and third divisions of our subject, for history should now be studied with a view of acquiring a knowledge of human nature; width of view and international sympathy; bearings of history on politics; and a perception of the meaning of the world's past history as it is unfolded in the philosophy of history.

The first of these has already been dwelt on as an object in the study of history, and the system of illustration by cumulative examples to which they have been accustomed since childhood by our method, will now prove a great help to solitary students in their endeavours after a more perfect

Knowledge of Human Nature.

A knowledge of human nature is perhaps the rarest, besides being one of the most valuable, of all human acquirements in secular subjects. The little that is possessed by most men is learned in the school of experience, where it is undeniable that one acquires more of such knowledge than in any other way; but still we may learn lessons of incalculable importance from the experience of others, and history may be looked upon as the experience of the ages.

The history of past ages forms, as it were, a kind of dissecting-room, where, with the lives of the dead laid open before him, the student may study the same springs of action that animate the living men around him, and may trace the working of the same emotions that are quivering in his own breast.

If he knows what to look for, every history he reads will enrich his experience of life. For this purpose the biographical element of history is of as great importance in its bearings on the individual life of the student as the collective life of a nation is valuable in throwing light on his social and political relations, that is, provided each be studied with these ends in view, for we seldom see what we do not look for.

The question then is, What are we to look for if we wish to gain a knowledge of human nature from our study of history? It is generally admitted that such knowledge ought to result from the study, but how are we to obtain the result sought?

We think the best way is to consider carefully how it is that we derive such knowledge naturally from the experience of life, and then to try how far we can use the natural method as our model in endeavouring to extract the advantages of experience from history.

An Inductive Process.—It is clear that the natural method of acquiring a knowledge of human nature is an inductive process, arising principally from a multiplication of examples proving that human beings have a tendency to certain lines of action in certain circumstances. The older people grow, if they have any observation, the more examples they accumulate, and the more confident their expectation of a certain uniformity of action in human affairs. A still higher form of the power thus acquired is that displayed by those who have the sagacity to see when the circumstances have changed, and consequently to expect a different result.

If certain conduct is to be confidently expected of human nature in certain circumstances, it is clear there must be some law to account for such uniform action—how are we to discover it? In the same way that we have discovered so many of the laws of physical nature—by induction from experiments—reasoning from the known to the unknown. But how can experiments be conducted here? Our answer is: History is the record of mankind's experiments in the art of living. These have hitherto been recorded simply as facts, almost without any effort to arrange them scientifically so as to convert them into knowledge. This must be done by sifting these facts, and classifying them so that they may throw light on the springs

of human action. Many writers have urged the necessity of studying cause and effect in history; but when this is done only by occasional and isolated examples, it does not leave any permanent result as knowledge: it is only (so to speak) by grouping together masses of cause and masses of effect that we can hope to discover the laws which they express.

Comparison of Similar Instances.—We must attain to knowledge of human nature by using the same method by which wise old men have gained theirs naturally, that is, we must multiply similar instances, and, whenever we find they have arisen out of similar circumstances, class them under one head, and go on accumulating till they gather in sufficient numbers to suggest a law of human nature. However, by the natural method this is necessarily a slow process, and it is only achieved in the course of a lifetime by a few men of exceptional sagacity and intelligence, who have brought keen observation and wise reflection to bear on their experience of life. Why not copy nature in her methods, and deliberately cultivate this valuable—this invaluable branch of knowledge, which has hitherto been acquired, as it were, accidentally? For thus we might graft some of the ripe wisdom of age on to the vigorous mental growth of youth, and might expect a rich harvest as the result.

The whole tendency of our method of teaching history has been leading up to this, and it is now that the training we have suggested would begin to bear fruit. For though the grouping of similar instances formed a prominent feature in our method of school teaching, it is not to be expected that children could derive the full benefit which such a system is capable of yielding to a mature mind. The reasoning powers necessary for such culture are not developed till later, neither is there sufficient experience of life to supply to any extent the essential element of comparison with the present. But it may nevertheless be admitted that such a method would not only greatly assist in the development of the reasoning powers, but would introduce the pupils to a profitable field for their use when fully developed. As the people who derive most benefit from the experience of life are those who have the habit of comparing the past with the present, and applying the results to their preparations for the future, the fostering of such powers of comparison in the young is of incalculable importance. And if this system, begun at school, were carried out in private study afterwards, its full benefits would be reaped, and would far exceed the small results obtained even by the studiously inclined, who have no distinct aim in their reading. Every one must have felt how wonderfully suggestive many a book is when read with an object, though perhaps the same work may have been mechanically gone through years before with very little interest. One who is accustomed thus to analyse and compare as he reads, is continually gaining new experience, and every book he reads adds to his culture, because, as some one has said, he possesses pegs on which to hang the facts that illustrate and extend previous knowledge. For, as Abercrombie says: 'The remembrance of insulated facts does not depend merely on the degree of attention directed to them, but also on the existence in the mind of subjects of thought with which the new fact may be associated.'* We take what we require, and leave the rest, so that we may be greatly benefited by a book, although we may ultimately forget a great part of its contents. It is impossible to remember all we read, and even if such a power were attainable, it would not be at all desirable, for our minds would be crammed so full that we should have no room for thinking.

The ideas we receive from reading form a kind of mental food, which we assimilate to supply our own wants, but which is itself consumed. The great object should be to select the proper food, and digest it carefully, if we wish to add to our strength of mind; and surely 'The proper study of mankind is man.' The results of such study as we have indicated would have a powerful influence on the race, for a thoughtful comparison of the different phases of human action in many nations, and at many different eras, would do a great deal to enlarge our sympathies, and clear away our prejudices, thus creating

Width of View and International Sympathy.

It has been said that a study of history has the same effect as travel in widening men's views and breaking down their prejudices, and we can easily understand how this should be the case. In travel we meet with people so different from those among whom we live that we cannot measure them by our usual standard, and are therefore obliged to widen it so as to admit the new features of humanity that come under our view. When this takes place, one who has been accustomed to generalise from the examples which come before him, is at first puzzled by the variety of character and change of circumstances; but after a time, order arises out of confusion, and, disregarding the differences caused by accidents of birth or surroundings, he learns to seize on the broad and salient features which distinguish human life, in all places and in all times, and he finds these touches of human nature which make 'the world akin.'

On the other hand, those who seldom move from one place to another, and are accustomed to meet always the same types of character, may display great sagacity in their estimate of these, but their views become unconsciously narrowed and illiberal. The narrowness of view common among uneducated people in provincial towns is a good example of this. The narrowness of class feeling is another example, for, whether manifested by exclusiveness and contempt in the upper classes, or envy and bitterness in the lower classes, it arises from the habit of generalising from an artificial and one-sided standard, founded on examples from one class only, instead of on the broader lines of universal humanity.

The exigencies of labour, and the unavoidable arrangements of society, make it almost impossible to avoid this narrowness—for the great masses of human beings are tied to the scenes of their daily toil, and have neither opportunity nor inclination to mix with any but their own class; while the advantages of foreign travel are rarely attainable. Therefore it is to education we must look for help, if we wish to enable them to see beyond their own limited horizon, and it is to history we must turn as our best ally in accustoming them to a wider outlook.

Importance of the study of history as a means of widening the views of those whose circumstances have a narrowing tendency.—Hence it is of great importance that the history course, especially in the common

* Abercrombie's 'Intellectual Powers.'

schools, should be very full and thorough: for the fewer the opportunities of widening the views of the pupils in after life, the more should be made of the short time at school in which it is possible.

Especially useful for this purpose would be the cumulative examples taken from the history of all countries, to which we alluded as a means of cultivating the judgment. Even the quickening of the imagination which would result from the method employed in the two years' course with which we propose to begin the study of history, would not be without effect in after years in its bearing on this matter of width of view; because it is this very faculty of imagination which enables us to enter into the feelings of others whose experiences are widely different from our own. Without such sympathetic intuition, even a varied experience of life does not ensure width of view, for it is not the mere passing through the experiences which affords such a result, but the being able to use them. So it is possible for some men to travel all over the world, and come home without being any wiser; as the German proverb expresses it:—

'Es flog ein Gänschen über den Rhein,
'Und kam er Gänschen wieder heim.'

(To be continued.)

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Lessons in Latin.

BY THE REV. A. D. CAPEL, M.A., CANTAB.,
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(*Continued from page 266.*)

KEY TO EXERCISES.

Exercise 57.

A.

1. If you, whoever you may be, wish to marry fitly, marry an equal. 2. Epaminondas used to think it impious to be angry with his country. 3. I prefer the most unjust peace to the most just war. 4. Does his father grudge the Roman citadels to Ascanius? 5. I always satisfy the rest; never myself. 6. We often put the eggs of ducks under hens. 7. These vices exist in love. 8. A wise man does not attend to bad speeches. 9. There is a plain lying between the Tiber and the walls of Rome. 10. With greatness of mind it is possible to fight against fortune.

B.

1. Altera frumentis quoniam favet, altera Baccho. 2. Parce pio generi. 3. Medetur animis philosophia. 4. Iracor tibi; sic meos amores. 5. Hoc tibi persuadeo: hoc probat ille mihi. 6. Utrique mortem est minitatus. 7. Postpono famæ pecuniam. 8. Sicilia quondam Italiæ adhæsit. 9. Gigantes bellum diis intulerunt. 10. Brutum copiis præfecit.

Exercise 58.

A.

1. It is desirable that a law should be short, that it may be the more easily comprehended by the ignorant. 2. He does not doubt but that Troy is about to perish in a short time. 3. Parmenio wished to deter Philip from drinking the medicine. 4. Solitudes did not protect Tiberius from confessing the torments of his breast. 5. Who is there but has heard (it)? 6. Old age is no impediment to our pursuing the study of literature. 7. Why- do we -not rather celebrate eternal peace and plighted wedlocks? 8. There is nothing which may not be spoilt by ill-telling. 9. I have left nothing undone to dissuade Pompey from his connection with Cæsar. 10. But! tell (me) forthwith.

B.

1. Fenestram aperuit quo melius videret. 2. Quis igitur dubitet, quin in virtute divitiæ sint. 3. Nihil tam difficile est, quin quærendo possit investigari. 4. Infesta concio vix inhiberi potuit, quin protinus saxa in Cæsarem jaceret. 5. Nihil obstat quin trabe vasta Ægæum rapias. 6. Quin corpus onustum hesternis vitiis animum quoque prægravat una. 7. Nihil prætermisi quin te hodie consequerer. 8. Nihil te obstat quominus hoc facias. 9. Quin, experiamur. 10. Nec requies, quin aut pomis exuberet annus, aut fœtu pecorum, aut cerealis mergite culmi.

Exercise 59.

A.

THE STAG AT THE FOUNTAIN.

This story shows that (those things) which you have despised are often found more useful than those things (which have been) praised.

A stag having drunk, rested at a fountain, and saw his image in the water. There, whilst admiring, he praises (Eng., admiring and praising) his branching horns, and finds fault with the excessive slenderness of his legs; suddenly frightened by the voices of hunters, he began to fly through the plain, and by his light running baffled the dogs. Then the wood received the wild beast, in which, hindered by his entangled horns, he began to be wounded by the cruel bites of the dogs. Then dying, he is said to have poured forth this saying (lit., voice): 'Oh, unhappy me! who now at length understand how (this meaning of 'quam' is omitted in the vocabulary) useful to me were (those things) which I had despised, and how much grief (those things) had which I had praised.'

B.

1. Contempseris, verb. act. from contemnere, 3rd conj., sub. mood, perfect tense, 2nd pers. sing., to agree with 'tu,' understood. 2. N. V. Fontes, Acc. Fontes, G. Fontium, D. Ab. Fontibus. 3. N. V. Effigies, Acc. Effigiem, G. Effigiei, D. Effigiei, Ab. Effigie. 4. See Key to Exercise. 5. All those tenses which are formed from the present and third roots. 6. Canis is a consonantal noun, though it has no more syllables in the gen. sing. than in the nom. 7. Me, *i.e.*, cervus. 8. Intelligo is a verb act., from intelligere, 3rd conj., ind. mood, pres. tense, 1st pers. sing., to agree with 'qui.' Note.—'Qui' is here = 'que ego.' 9. Laudaveram. 10. Partitive genitive—lit., 'How much of grief.' See Lesson 46.

LESSON LX.

Final and Consequent Clause and Sequence of Tenses.

477. The Latins very often used the subjunctive mood where we use either the infinitive or the indicative. This has been already referred to in the Lesson (No. 36) on the infinitive with its subject.

478. A final clause is one that expresses the end or purpose for which the principal clause takes place, and in English is very often expressed by the infinitive mood—as, 'We eat to live.'

479. In Latin an infinitive never expresses a purpose or an end. Such a clause must be put into the subjunctive mood—thus, 'Edimus ut vivamus,' which literally means, 'We eat that we may live.'

480. A negative in a *final* clause is always joined with the conjunction—thus, 'that not' in the sentence, 'The physician gave him medicine, *that* he might *not* die,' would not be 'ut non,' but the one word 'ne.'

481. A clause expressing a consequence has its verb in the subjunctive mood, but here the 'ut non' for 'that not' is used.

482. By the term 'Sequence of Tenses' we mean the laws which regulate what tenses in the dependent clause may follow those found in the principal clause.

483. In the infinitive mood the Latins have only three forms; but there are no less, on that account, five, if not six, tenses—the form for the imperfect being the same as the present, and that for the pluperfect the same as the perfect. Strictly, then, in parsing we ought to call 'amavisse' perfect or pluperfect, according to the tense of the verb on which it depends.

484. In this exercise sentences including final clauses will be mixed up with those including an infinitive which is really a verbal substantive.

485. To repeat what I said in paragraphs 265, 270—If an infinitive mood in English answer the question 'What?' to the principal clause, it remains in the infinitive mood in Latin; but if it answers the question 'Why?' it must be changed into a clause introduced by a conjunction which will have its verb in the subjunctive mood.

486. Conversely, if a clause connected by a conjunction with another clause answers the question 'What?' to its principal sentence, the verb of this clause is in Latin put in the infinitive mood, its subject into the accusative case, and the conjunction omitted altogether.

487. Remember that verbs of asking, advising, commanding, and striving, and also of fearing, have the verbs in clauses depending on them in the subjunctive mood.

488. The verbs metuĕre, timēre, and verēri (deponent), which mean 'to fear,' are followed by 'ne' where we omit the 'not,' and by 'ut' where we express it; but we use the word 'lest,' which is often equivalent to 'that not,' with these verbs as the Latins used 'ne.'

THE SEQUENCE OF TENSES.

Principal Clause.		*Dependent Clause.*
Present, Perfect (with 'Have'), Future	are followed by	Present, or Perfect (if previous to time of principal clause).
Imperfect, Perfect (without 'Have'), Pluperfect	are followed by	Imperfect, or Pluperfect (if previous to time of principal clause).

490. VOCABULARY 60.

English.	*Latin.*		*Derivatives.*
Alone	sōlus (omitted in Vocab. 31),	G. solius, D. soli.	
To happen	contingĕre	P. R. contig	3rd R. contact
To look around	circumspicĕrĕ	P. R. -spex	3rd R. -spect expect
Next (after)	postĕrus -ra -rum	G. poster	posterity
To decree	ēdīcĕre	P. R. edix	3rd R. edict
To go together, To assemble	coīre (See Less. 56)		
To grow tame	mītēscĕre	No P. R.	No 3rd R.
Instruction	cultūra	G. culturæ	culture
To relieve	rĕlĕvāre	R. relev	
To put between	interpōnĕre	P. R. interpōsu	3rd R. interpōsīt
A care	cūra	G. curæ	
Any	quīvis, quævis, quodvis		
To bear	sufferre	P. R. sustŭl	3rd R. sublāt
To fear	mĕtuĕre	P. R. metu	No 3rd R.
Flatterer	ădūlātor	G. adulatoris	
To fear	vĕrēri, dep.		3rd R. vērit
Word	verbum	G. verbi, n.g.	verbal
Little book	lĭbellus	G. libelli	libel
Fleet	classis	G. classis	classic
To kill	nĕcāre	R. nec	
To stop	dēsistĕre	P. R. destĭt	3rd R. destit
Sadness	mæror	G. mærōris	
Pompey	Pompeius	G. Pompei	
Funeral	fūnus	G. funĕris, n.g.	
Groan	gĕmĭtus	G. gemitūs	
To fall into	incidĕre	P. R. incid	3rd R. in.it
Anew	dēnuo, adv. for de novo		
By chance	forte, adv.		
To be sick	ægrōtāre	R. ægrot	
Marriage	nuptiæ (no sing.)	A decl.	
Early	mātūrē		
To decrease	minuĕre	P. R. minu	3rd R. minūt
To increase	augĕre	P. R. aux	3rd R. auct

491. EXERCISE 60.

A.

1. Soli id (37) contingit sapienti (49), ut nihil (31) faciat (43) invitus (translate as an adverb) (52). 2. Vēnit (19) hodie (58) ut circumspiciat, ut vinceret (54) hesterno (58) die (8) vēnit (19). 3. Postero die (8) rex (8) edixit omnes (29) armati (2) (agreeing with subject understood of 'coirent') coirent. 4. Nemo (17) adeo (46) ferus (50) est ut non mitescere possit (50) si modo (50) culturæ patientem (50) commodet (50) aurem (50). 5. Non est in medico (29) semper (33), relevetur ut æger (35). 6. Interpone tuis (20) interdum (23) gaudia (27) curis, ut possis (50) animo (54) quemvis sufferre laborem (12). 7. Ne tibi (35) quid (for 'aliquid,' 45) desit (50), quæsitis (56) utere (45) parce (Eng., sparingly); utque, quod ('tibi' understood) est, serves (10), semper tibi (35) deesse (50) putato (49). 8. Metuo ne frustra (61) laborem (12) susceperis (47). 9. Adulatores si aliquem (45) laudant (2), vereri se (35) dicunt (15), ut illius (37) facta (45) verbis consequi (Eng., imitate) possint (50). 10. Cur (33) non mitto (43) meos (20) tibi (35) Pontiliane (Eng., Pontilianus) libellos? Ne mihi (35) tu (35) mittas (43), Pontiliane, tuos (20) (Epigram of Martial's).

B.

1. We eat (33) to live (48); we do not live to eat. 2. Themistocles (Lat., same word) persuaded (16) the people (16) that a fleet should be built (17). 3. Pylades (Lat., same word) said (15) that he (35) was (38) Orestes (Acc. Oresten), that he might be killed for (28) him (37). 4. We do not stop advising (30) Pompey to fly-from (27) infamy (44). 5. Let us leave (26) sadness to (our) friends (5), that they may celebrate (52) (our) funerals with (20) a groan. 6. Anger (40) hinders (59) the mind (54) that it cannot (50) perceive (37) the true (sing.) (29). 7. Take care (52) not to fall anew into (express prep.) disease (26). 8. Then (20) by chance I was ill (imperf.), so that I was not able (50) to come (19) to (10) thy (20) marriage. 9. I fear that he may not come (19) early (that is, in time). 10. I fear lest whilst (21) I wish (pres. sub.) (53) to decrease (your) labour (12) I may increase (it).

LESSON LXI.

GENDER OF 'I' AND CONSONANTAL NOUNS—LATIN PROVERBS.

492. The gender of inanimate objects may be sometimes discovered by the class to which they belong, and sometimes by the terminations of their nominative cases.

493. As to classes. The masculine nouns are the

names of winds, rivers, and most mountains. The feminine nouns are the names of most trees (including 'arbor' itself, a single exception to nouns ending in 'or,' all others being masculine), islands, countries, and cities.

494. As to terminations: The masculine nouns, with exceptions, end in 'er,' 'or,' 'os,' 'es' when consonantal, 'o' when not, 'do,' 'go,' or 'io' The feminine nouns, with exceptions, end in 'do,' 'go,' 'io' (all of which are abstract nouns), 'as,' 'is,' 'aus,' 'x,' 'es' ('I' nouns), and 's' impure (that is, preceded by a consonant, as 'mons'), and 'us' when root ends in long syllable, as 'virtus,' R. 'virtūt.'

495. Neuter nouns of this declension end in 'a,' 'e,' 'c,' 't,' 'l,' 'n,' 'ar,' 'ur,' and 'us,' when root ends in short syllable, as 'onus,' R. 'onĕr.'

496. The masculine exceptions of words ending in 'is' are the most numerous and the most common.

497. The student is advised to commit the following connected nonsense to memory. It contains all the principal exceptions of this class, which can be, perhaps, more easily remembered in this way than any other:—

Last *month* (mensis), on my *birthday* (natalis), I went up a *hill* (collis), which was covered with *dust* (pulvis), *ashes* (cinis), and *stones* (lapis), on the top of which I saw some *bread* (panis) and a *fish* (piscis). Out of the latter there crawled a *worm* (vermis), which made its way for a broken *axle* (axis), which was tied by a *rope* (funis) to the *stalk* (caulis) of a gigantic *cucumber* (cucumis).

At the *end* (finis) of my walk, I turned and saw beneath me, close to where a *canal* (canalis) ran into a *river* (amnis), a large *fire* (ignis) of burning *fagots* (fascis) placed in a *circle* (orbis), which had been lit by a *firebrand* (torris). Close to it there was a soldier of the *front ranks* (antes, no sing.) with his *helmet* (cassis) on, stealing a *purse* (follis), to do which he had sent a woman to the *shades* (manes, no sing.) by striking her with a *club* (fustis), and was beginning to cut off her *hair* (crinis) with his *sword* (ensis) to stop the *blood* (sanguis) she had drawn from him with her *nails* (unguis). He then threw her behind a *door* (postis), which he opened with a *lever* (vectis).

498. The exercises this month contain a quantity of Latin proverbs which will interest the student.

499. VOCABULARY 61.

English.	*Latin.*		*Derivatives.*
To fear	timēre	P. R. timu	No 3rd R.
Whoever	quisquis (See Less. 50.)		
Honest	hŏnestus -ta -tum	R. honest	
Star	astrum	G. astri, n.g.	astronomy
Soft	mollis -le	G. mollis	mollify
Full	plēnus -na -num	R. plen	plenipotentiary
To look upon	aspicĕre	P. R. aspex	3rd R. aspect
Hand	mānŭs	G. manūs (exc. f.g.)	manufacture
Secretly	sēcrēto, adv.		secrete
To admonish	admŏnēre	P. R. admonu	admonit
Opinion	ŏpīnio	G. opinōnis	opinionated
To correct	emendāre	R. emend	emendation
Twice	bis, adv.		biscuit
Quickly	cīto, adv.		
In vain	frustrā, adv.		frustrate
Remedy	rĕmĕdium	G. remedii, n g.	
Lightning	fulmen	G. fulminis, n.g.	fulminate
Cautious	cautus -ta -tum	R. caut	
Mean	sordidus -da -dum	R. sordid	sordid
Frugal	parcus -ca -cum	R. parc	parsimony
To wish for	optāre	R. opt	option
Foolish	stultus -ta -tum	R. stult	stultify
To cherish	fŏvēre	P. R. fōv	3rd R. fōt
Too much	nimium, adv.		
Hard	dūrus -ra -rum	R. dur	endure

500. EXERCISE 61.

A.

1. Amor (49) timere neminem (17) verus (29) potest (50). 2. Bonis (20) nocet (50) quisquis pepercerit (57) malis (33). 3. Honesta mors (8) est pro (28) bona (20) causa (37) mori (inf. mood., wrongly printed 'moriri' in Voc. 59). 4. Multos (20) timere debet (46) quem (27) multi timent. 5. Non est ad (10) astra mollis e (for 'ex,' 26) terris (8) via (48). 6. Puras (45) deus (27), non plenas aspicit manus. 7. Secreto amicos (5) admone, lauda (2) palam (53). 8. Ab (39) alio (31) expectes (52), alteri (31) quod (27) feceris (43). 9. Quem (27) pœnitet (48) peccavisse (3) pœne (20) est innocens (48). 10. Bona (20) opinio hominum (5) tutior (49) pecunia (45) est.

B.

1. From (26) the vice (46) of the other (31) let a wise-man (49) correct his own (20). 2. You wish (53) to have (7) great (20) power (19); rule (4) thyself (35). 3. He gives (12) twice, who (27) gives quickly. 4. It is in vain to seek (56) a remedy against (17) lightning. 5. The timid-man (20) calls (11) himself (35) cautious, the mean-man (calls himself) frugal. 6. The grief (pain, 39) is light (49) which (27) is able (50) to take (26) counsel (40). 7. Youths (41) easily (29) learn (27) bad (33) (use comp. degree) precepts (50). 8. To die (see A, 3) without (31) the fear (16) of death (8) is a death to be wished for. 9. Fortune (40) makes (43) (him) foolish whom (27) she cherishes too-much. 10. It is sweet (29) to remember (46) what (plural 27) was hard to suffer (45).

LESSON LXII.

CONDITIONAL SENTENCES.

501. A conditional sentence has two parts, viz., the condition, called the protasis, and the consequence, called the apodosis—*e.g.*, 'I had perished (the apodosis) unless you had assisted me (protasis).'

502. The difficulty of these sentences consists in the question as to what mood we ought to use.

503. Generally speaking, the indicative mood is the one we use when telling facts which either have happened or will happen, whereas we use the subjunctive when a proposition is stated as something conceived by the mind as possible, desirable, or contingent.

504. A difference in meaning has been discovered in the four tenses of the subjunctive, both when standing alone and in conditional propositions. The present and perfect describe some action or event as conceived of by the mind, without necessarily implying that it does not or may not exist; the imperfect and pluperfect exclude the idea of its actual or possible existence at the time that it is spoken of.

505. In the consequent members (apodosis) of a conditional proposition the past tenses are frequently put in the indicative, to give more liveliness to the representation. This change is really a grammatical figure, very much like that of using the present for the future, as it implies that what *may* happen *has* happened; just as in using the future for the present it is implied that what *will* happen *is* happening.

506. The best grammarians, however, state that no rules can be laid down on this difficult subject.

507. The student is begged to compare carefully the sentences in this exercise with the translations in the Key. All the sentences, in both parts, are from classical authors.

508. VOCABULARY 62.

English.	*Latin.*		*Derivatives.*
To hasten	accurrĕre	P. R. accurr	3rd R. accurs
To tear down	divellĕre	P. R. divuls	3rd R. divuls
A command	jussus	G. jussus	
To be well / To be strong / To be healthy	vălĕre	P. R. vălu	3rd R. valit
To say	dīcĕre	P. R. dix	3rd R. dict
Tolerable	tŏlĕrābĭlis -le		
To hasten	appropĕrāre	R. approper	
A deed / A crime	făcinus	G. facinoris, n.g.	
A place	lŏcus	G. loci	locate
Made of piles	Sublicius -a -um	R. Sublici	
(This particular bridge at Rome was always called 'Pons Sublicius'; just as we might say 'the Suspension Bridge.')			
To give	dăre	P. R. dĕd	3rd R. dăt
Sober	sobrius -ia -um	R. sobri	sobriety
To be mad	insānire	P. R. insaniv	insanit
Large	grandis -de	G. grandis	grandee
Vessel (not ship)	vās	G. vāsis, n.g.	vase
To deny / To refuse	dēnĕgāre	R. deneg	
Illustrious	clārus -ra -rum	R. clar	
To admire	admīrāri, dep.	3rd R. admirāt	

EXERCISE 62.

A.

1. Perieram (56) nisi (43) tu (35) accurrisses. 2. Populus (16) effigies (22) Pisonis divellebant ('lively'—see par. 505—for divellerent) nisi (43) jussu principis (43) protectæ (58) essent. 3. Si (15) valeant homines (5) ars (49) tua (20) Phœbe jacet (49). 4. Antoni (for Antonii) gladios potuit (50) contemnere (49) si (15) sic (50) omnia (29) dixisset. 5. Omnia (29) brevia (49) tolerabilia esse debent (46) etiamsi (56) magna (20) sint (38). 6. Ista (40) veritas (45), etiamsi (56) jucunda (21) non est, mihi (35) tamen grata (57) est. 7. Concionem (58) Clodius, nisi (43) ad (10) cogitatum (52) facinus approperaret, nunquam (28) reliquisset (26). 8. Et, si (15) non aliquâ (Eng., in some way) nocuisses (50), mortuus esses (59). 9. Etsi (50) culpa (45) tenemur (18), scelere (48) liberati sumus (12). 10. Hunc (37) patris (14) loco, si (15) ulla (31) in te (35) pietās (41) esset (38).

B.

1. The bridge (42) made-of-piles had almost (20) given (perf. ind., see par. 505) a route (53) to the enemy (10) unless (43) there had been (38) one (31) man (18) (viz.), Horatius Cocles. 2. No one (17) (who is) sober dances (2), unless (43) by-chance (60) he is mad. 3. If (15) you are-in-good-health it is well (55). 4. If (15) there was any (use 'qui' for 'aliquis') large vessel they were joyfully (33) (use adj.) bringing (52) it. 5. You would not refuse to give if (15) I wish (53) for more (49). 6. If (15) he were (38) on the earth (use plur., 8), Democritus would laugh (33). 7. If (15) I had known (14) that (37), I would never (28) have come (use 'ferre (53) pedem') hither (16). 8. If (15) you were (38) an Athenian (46), you would never (28) have been (38) illustrious. 9. Although (56) he was not that (37) Cæsar which (27) he is, yet (20) he seemed (51) fit-to-be commended (proper part of 'ornare'). 10. If (15) I have ever seemed (51) brave (51) to you (35), you would surely (38) have admired me (35) in that (37) cause (37).

EXAMINATION QUESTIONS.

No. 6.

1. What part of the comparative adjective do you use for the adverb? 2. What is the difference in meaning between 'ne lude' and 'ne luderis'? 3. What do you understand by the term 'indirect narration,' and in what mood are the verbs of the dependent clauses? 4. What is the force of a single question introduced by 'num' or 'an'? and distinguish between them. 5. In the expressions, 'I hurt you?' and 'I persuade you,' show that the 'you's' are indirect objects. What are the respective direct objects of these sentences? 6. What is 'quo' a contraction for, and when do we use it? 7. After what kind of verbs do we find 'quominus'? 8. Distinguish between final, consequent, and conditional clauses. 9. In what clauses do we write 'ne' for 'ut non'? 10. By what tenses, respectively, in the dependent clause are the verbs 'I came' and 'I have come' followed?

(To be continued.)

—o—

Lectures on Shakspere's 'Tempest.'

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No. VII.

FROM ACT IV., SC. 1, line 120 TO ACT V., SC. 1, line 94.

(The figures in brackets refer to the pages of the Clarendon Press Edition.)

FASCINATED by the beauty of Miranda, and struck by the power of the benignant old magician, her father, Ferdinand is willing to pass his life in the enchanted isle. He speaks of Prospero as '*a wondered father*,' which we must accept as the equivalent of 'a father able to perform wonders.'

'*Windring brooks*' and '*crisp channels*' mean, probably, 'wandering brooks' and 'winding channels,' unless we prefer that explanation of *crisp* which would prompt us to translate the latter passage, 'channels in which the water curls or ripples.'

'*Country footing*' is, of course, country dancing, in which rustic couples would 'fleetly foot it to and fro.' By the way, the student must remember that a 'country dance' has nothing to do with the country, so far as regards the *derivation* of the word, which is from the French preposition *contre*.

'*A moved sort*' (153) may, perhaps, be explained as 'an agitated state.' Now comes that magnificent passage beginning, '*The cloud-capped towers*,' etc. Though learned by heart, as they generally are in early youth, those grand lines never seem to lose their fascination. You will notice, of course, that '*all which it inherit*' means 'all who inherit it.' The word *rack* is variously explained, as (1) 'a cloud,' and (2) 'a wreck or remnant.'

'*Our little life*,' says the poet,' *is rounded* (*i.e.*, finished off) *with a sleep*'—that is to say, death is the end or completion of it. The enchanter declares his intention of taking a short walk in order to still his '*beating mind*.' *Beating* here means 'agitated.' In Act I., Sc. 2, we find the passage, '*'tis beating in my mind*'; and in Act V., Sc. 1, occur the words, '*Do not infest your mind with beating on the strangeness of this business*.' Mr. Wright suggests 'working violently' as the equivalent

of *beating* in the first quotation. 'Thinking anxiously' will, perhaps, express its meaning in the other.

'*With a thought*' is much the same as 'in an instant.' We frequently use the comparison, 'Swift as thought.'

The expression '*meet with*' (166) means 'to counteract.' It may be worth noticing that a duel is often spoken of as 'a meeting'—that is to say, a meeting for a hostile purpose.

'*Red-hot with drinking*' is a curious phrase. It probably refers to the flushed and heated appearance of these worthy men's faces.

'*Unbacked colts*' are young horses that have never been ridden. '*As they smelt music*' = 'as if they detected music by the sense of smell.' Why is the stagnant pool said to be *filthy mantled*? What is called its mantle is the green scum that floats on the surface. A very clever suggestion is that we should read *filth-ymantled* instead of *filthy mantled*. '*O'erstunk their feet*' is a condensed expression for 'flowed over their feet and smelt disagreeably.'

The three nouns *trumpery*, *stale*, and *nurture* mean respectively 'property of little or no value,' 'bait or decoy,' and 'education.' 'Nurture' has much the same meaning in the sixth chapter of the Epistle to the Ephesians, where occur the words, 'the nurture and admonition of the Lord.'

'*Played the Jack with us*' is the same as 'deceived us'—for the tricksy Ariel has led them about like an *ignis fatuus*, or 'Jack o' Lantern,' by which travellers are frequently decoyed into the mire. When Caliban says '*The prize I'll bring thee to shall hoodwink this mischance*,' he means that the gain to be got by robbing Prospero will cover or efface from recollection their previous misfortune.

Foot-licker is a very expressive word for a fawning menial.

'*Let's alone*' = 'Let you and I go and do the murder, and leave Trinculo, who is so anxious about this miserable clothing.'

Next comes the passage about the jerkin. What ingenuity has been spent over that miserable witticism! In spite of all attempts to trace it, the wit seems to have evaporated, if indeed it ever was there. Still we are bound to offer a remark or two, and the candidate will not be excused for neglecting the passage, if it should find its way into the examination paper. If '*to strike the ball under the line*' means 'to lose,' then the statement that the jerkin is under the line probably means that the jerkin is lost. Stephano says jocularly that it is as good as lost, inasmuch as he has made up his mind to steal it. But what about the jerkin losing its hair? We are told that people who cross the Line (Equator) get fevers, and so lose their hair. But what has this to do with the jerkin being stolen?

'*To steal by line and level*,' is to steal methodically, or on a system, and a '*pass of pate*' is a witticism. There is something very funny, Stephano thinks, in systematic stealing. Perhaps there is; but the wit is not very obvious. It is, indeed, a fortunate thing for the world-renowned dramatist that his fame is not dependent upon his attempts at humour!

Caliban's apprehension that the whole *posse* of conspirators may be turned to barnacles only embodies and gives expression to the absurdly ignorant ideas of the time. Three hundred years ago people believed in 'metamorphoses' as firmly as did Ovid himself.

There is little more to be noticed in this Act, except the illustration of the use of an adjective for an adverb, which is afforded us by the words *villainous low*; the phrase *lay to* in the sense of 'apply' ('*lay to your fingers*'); the expression *aged cramps*, which is the same as *old cramps*, or 'plenty of cramps,' which we met with in Act I. Sc. 2, line 370; '*pard, or cat o' mountain*,' for 'panther or leopard'; and lastly, '*lies at my mercy*' for 'lie at my mercy'—another exemplification of that use of the plural for the singular which we have already met with more than once, and which we have classed among the grammatical peculiarities of Shakspere. All we can say is that when the verb precedes the plural noun that governs it, Shakspere frequently puts it in the singular. But this construction was no more grammatically correct in Shakspere's time than it is in our own.

Act V.

Prospero begins by saying that his schemes are working successfully towards completion. In three lines he uses as many metaphors—'My project *gathers to a head*,' like a boil or swelling; '*My charms* (like pottery which is being baked successfully) *do not crack*;' 'Time *goes upright with his carriage*,' *i.e.*, bends not under the burden. All that this can possibly mean is that the critical period of his life is proceeding just as he could wish. But it must be conceded that the language, though capable of being translated, is in a high degree strained and pedantic.

In '*the king and 's followers*' we have the rather unusual contraction of *and 's* for 'and his.'

A *line-grove* is a grove of lime-trees. It is scarcely necessary, perhaps, to observe that *weather-fends* is an abbreviated phrase for 'protects against the weather.' It is interesting to notice that *budge*, which we should hardly class among elegant English expressions, has the sanction of Shakspere. You would hardly suspect, either, that '*till your release*' meant 'till released by you.' All the possessive pronouns, though less so in English than the phrases which contain *of*, are susceptible of both a subjective and an objective application. Take, for instance, the words 'the fear of the English.' This might mean, according to circumstances, either the fear which the English inspire in other people, or the fear felt by the English themselves.

In '*passion as they*' there is no doubt that *passion* is a verb. Even if the comma after *sharply* were removed, there would be no sense in 'relish passion all as sharply as they,' such a phrase as 'to relish passion' not being found in our literature. '*Stung to the quick*' is a common enough phrase, though not every one, perhaps, remembers that *quick* means 'living,' as in the expression 'the quick and the dead.' A finger nail, we say, has been 'cut to the quick' when it has been pared down as far as the living and sensitive flesh by which it is surrounded.

'*The rarer action is in virtue, than in vengeance*' is, perhaps, a somewhat elaborate mode of expressing 'Good conduct is nobler than vengeance,' or, if the particular virtue meant is forgiveness, then 'Forgiveness is better than revenge.'

We have an instance of the 'absolute' construction in '*they being penitent*,' which means, of course, 'if they are penitent,' such repentance being the condition of Prospero's forgiveness.

'*Not a frown further*' contains an intimation that Prospero will not only forbear to punish, but will even refrain from showing his displeasure by his looks.

A '*printless foot*' is a foot that leaves no traces, which, of course, must be a very light one.

To '*chase and fly the ebbing Neptune*' is a poetical rendering of an extremely simple idea, *viz.*, running into the sea when the water is receding, and scampering back again when the wave returns. Notice the transposition of the negative in '*not bites*,' and compare with it '*I not doubt*,' which occurs in II., 1, line 116.

By '*weak masters though ye be*' Prospero means 'though you are but weak masters of these supernatural powers,' or 'possess these powers only in a very low degree.' Even with these he has been enabled, as he asserts, to invert the course of nature. '*Their senses, that this airy charm is for*' is a concise expression for 'The senses of those for whom this airy charm is intended.'

'*Sociable to the show of thine*' (59) means, most likely, 'sympathising with what appears in yours,' *i.e.*, the trace of tears; and '*fellowly drops*' means, of course, 'sympathetic tears.' *Fall*, for 'let fall,' occurred before, in Act II., Sc. 1, '*To fall it* (let it fall) *on Gonzalo*.'

'*Ignorant fumes*' is an expression meaning either 'fumes of ignorance' (that is to say, delusion that obscures the mind as a mist obscures material objects) or 'fumes that produce ignorance,' that is (in this case), 'misleading delusions.' In '*a loyal sir*' for 'a loyal gentleman,' we seem to have a parallel construction to the use of 'she' for woman. Notice that *remorse* here means 'pity,' and not 'sorrow for the perpetration of a crime.' We have a bold metaphor in the passage which contains the words, '*the reasonable shore*.' Reason is compared to a shore that lies foul and muddy at low water. The return of proper ideas (*i.e.*, a sense of the wickedness of their behaviour) is compared to the rising of the tide, by which the shore will be swept and purified. The metaphor has been a little confused by the previous mention of *fumes*, which are a pollution of the atmosphere rather than of the ground. But this 'mixture of metaphors' is a thing of frequent occurrence in Shakspere.

A word as to Ariel's song, which, as most of us know, has been many times set to music. The critics object to the poet's speaking of the bat as though it were a bird of passage, which it certainly is not. It is the swallow rather than the bat that 'flies after summer'; but poetry is above the laws of scientific accuracy, and, in fact, not one person in ten, perhaps, would notice this incongruity until pointed out to him.

(*To be concluded in our next.*)

How I Teach Domestic Economy.

BY MRS. WIGLEY.

Author of 'Marshfield Maidens,' 'Our Home Work,' 'Workers at Home,' 'Royal Series Domestic Economy,' 'Cookery and Home Comforts,' 'The Merryweathers,' 'Thoughts,' etc.

CHAPTER VIII.

OUR INTERNAL HEAT.

In our last paper we considered just so much, or rather, just so little of the science of physiology as will enable our children to understand the way in which the food is appropriated for the supply of our body's needs.

But the building up of the various parts, or repairing the daily loss of material, is not the only work which has to be done by the food we eat. It has also to supply heat and energy. Therefore it becomes necessary that we shall also make this matter clear to the little minds under our training.

Here again we shall doubtless have to take them over ground that is new to them, and in a series of lessons give them information enough to make the following facts plain to them.

The air we breathe is a mixture of two gases, Oxygen and Nitrogen. Without oxygen fires would not burn, nor could any living creatures breathe. As soon as all the oxygen is used up out of the air in any place, then that place is not fit for us to remain in. If we did stay in it we should be suffocated and die. The same gas that enables the fire to burn also enables us to breathe.

Look at this tumbler, it is clear and bright, and there is nothing in it but some of the air which is all round us, which is a mixture of oxygen and nitrogen as I told you. Now here is a small piece of candle. I light the candle, place it on this piece of paper and turn the tumbler down over it. Now watch the flame. You see that it burns dimmer and dimmer, and now it goes quite out. It goes out before it has used up all the oxygen, owing to the presence of another gas which is produced by the burning of the candle. Was anything else used up besides the oxygen? Oh yes, some of the wick and some of the tallow was used as well as the gas. Now where has the gas and the candle that burned away gone to?

Did you ever hear that it is impossible to do away with anything in the world? We may alter things and change their look and their power, but we cannot quite destroy them. We light a fire, and we use coal and wood and paper, but we cannot say, 'Now I have quite destroyed that coal and wood and paper;' for part of these things will lie under the grate in the form of ashes, and part will have gone up the chimney in the form of gas and smoke.

So that nothing in nature can be destroyed. Where, then, is the wick of the candle, and the oxygen gas, and the tallow gone to? They could not be done away with, but they have been changed. If you look at the tumbler you will see that it seems filled with something like white smoke. It also contains some water-vapour and carbonic acid gas, but both these are invisible. Wood, coal, oil, and gas all contain carbon.

But carbon cannot be burned or consumed without oxygen. If the tumbler had contained oxygen enough the burning would have gone on until there was no more carbon left in the wick or the tallow of the candle.

Directly oxygen and carbon are brought together, at a sufficiently high temperature, no matter where the carbon is found, or where the oxygen comes from, the carbon begins to consume, and the oxygen and carbon together join to form another gas, which we said was carbonic acid gas.

And something else happens also. Whenever anything is consumed there is *heat* formed. You know this is so in the grate, and there you see the fire and flame as well as feel the heat, but it is quite as true when we do *not* see the fire and the flame. If your father is a gardener, and he wants to grow melons and cucumbers, or to bring on some early potatoes very quickly, what does he do? He puts his plants in the frame, and he piles all round it manure or other decaying matter. And if you ask

him about it, he will tell you that all decaying matter gives out heat, and that he wants the heat round the frame to make his plants grow quickly.

Sometimes when hay is put together before it is enough dried by the sun, it begins to decay in the middle, and it gets hotter and hotter, till it is scorched and black, and then, if the farmer does not let the cold air into it and spread it out again, it will catch light and burn all away.

Now remember this: all decay, all rotting of heaps, all consuming and all burning, is caused by the union of oxygen and carbon, and in the burning, consuming, rotting, or decaying, not only is carbonic acid gas formed, and some other gases, but heat also is given out. It may not be enough heat to cause a flame or a fire, but there is always some.

Now let us go a step further, and see how all these things affect ourselves.

Some sorts of the food we eat are very rich in carbon, and we call such foods carbonaceous foods, but all food contains some. When this food has been reduced by our digestive organs it is carried in the blood to every part of the body, to nourish the body and become part of it. The body itself is gradually used up or burnt away by the oxygen conveyed to it by the blood. As the blood returns to the lungs it is highly charged with carbonic acid, and there it meets the air we breathe in, which contains the oxygen.

It is this burning or consuming of the carbon of our bodies by oxygen that goes on within us which causes our internal heat. You know what happens when you move quickly by running, or skipping, or working hard. The more you use your muscles, the more rapidly they burn away, the more carbonic acid you give off, the more oxygen you require. You breathe more air and you are hotter.

Erratum.—On page 248, read 'bare subject' instead of a 'rare subject.'

(To be continued.)

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Chemistry of the Non-Metallics.

[This series of articles, whilst dealing with the subjects required by the University of London for the Matriculation Examination and with those required at the Elementary Stage of the Inorganic Chemistry (Branch X.) Science and Art Department, is intended as a practical guide to the philosophical and systematic study of the non-metallics.]

CHAPTER XII.

Carbon. Its Forms. Preparation. Properties. Heat of Combustion.

A. C.

B. 12.

C. Carbon exists in three forms: diamond, graphite, charcoal.

The preparations and properties of each of these will be studied separately.

1. *Diamond.*—Found native in the earth. It is a surface product, occurring at no great depths in Peru, Brazil, the Cape, etc.

2. *Graphite* (γραφω [grapho] = I write) plumbago (plumbum = lead), or blacklead, because of its appearance. Found native in Borrodaile in Westmoreland, in Cornwall, the Isle of Man, and in Ceylon.

Graphite can also be prepared artificially from charcoal. If iron is heated in contact with more charcoal than it can take up, so as to form steel, the excess of the carbon as the temperature falls crystallises out as graphite.

Graphite can be prepared artificially from diamond. A diamond placed in the voltaic arc for some time swells up, and becomes black, opaque, graphitoid. These two experiments serve to show the identity of the three forms of carbon.

3. *Charcoal.*—The four chief elements present in organic bodies are carbon, hydrogen, oxygen, nitrogen. Of these, the three last are gases at ordinary temperatures. Carbon only of the four is a solid at ordinary temperatures. When organic bodies are heated, the hydrogen, oxygen, nitrogen pass off as gas, and the carbon is left. The hardest parts of vegetables or animals are chosen for the making of charcoal, as they contain most carbon. Thus the wood of vegetables and the bones of animals yield most charcoal.

Place a small piece of wood, such as a match with the top cut off, in a test-tube, and apply heat. The wood becomes carbonised.

Make a strong solution of sugar, and pour on it strong sulphuric acid. The sugar becomes carbonised.

D. *Diamond.*

(1) Solid, not melting at any temperature as yet reached Crystalline. Its shape is octahedral or cubical.

(2) The hardest body known, except, perhaps, boron. The diamond is without taste, odour, or colour; a very strong refractor and reflector of light.

(3) About 3·5, compared with water.

(4) Not soluble in any liquid known.

(5) Not combustible, except at very high temperature in pure oxygen, when it forms carbon dioxide.

(6) Does not conduct heat or electricity. Used to cut glass, and for ornament.

Graphite.

(1) Solid, crystalline; form, hexagonal prism. Hence, as carbon exists in two different crystalline forms, the octahedral of the diamond, and the hexagonal of graphite, the element is called dimorphic; δις (dis) = two, μορφη (morphē) = form.

(2) Friable, but the ultimate particles hard; without taste or odour; black, with a feeble metallic lustre.

(3) Variable; about 2·2.

(4) Insoluble.

(5) Not combustible except at very high temperatures, when it forms carbon dioxide.

(6) Very inert. Conducts electricity. Used for the making of crucibles that have to be subjected to a high temperature in furnaces, and for coating machinery, with the object of preventing rust.

Charcoal.—Either vegetable or animal.

(1) Solid. Not crystalline, but powdery or amorphous (α = without.) Hence, as carbon exists not only in the crystalline form, but also as an irregular mass, it is called allotropic. αλλος (allos) = another, τροπος (tropos) = manner. A dimorphic body is one that has more than one crystalline form; an allotropic body is one that exists not only as a crystal, but in the amorphous condition. Carbon is both dimorphic and allotropic.

(2) Without taste, odour, or colour.

(3) Very variable. Vegetable charcoal appears often to be lighter than water because of the many pores within it, but when water has entered into the spaces in the charcoal the latter sinks in water.

(4) Insoluble.

(5) Not combustible, except at high temperatures, when it forms carbon dioxide. The fact that all three forms of carbon unite with oxygen to form the same compound, is another proof of their chemical identity.

$$\begin{array}{rrl} C+ & O^2 & = CO^2 \\ 12+ & 32 & = 44 \\ & 2 \text{ vols.} & 2 \text{ vols.} \end{array}$$

When carbon is burnt, a definite quantity of heat is given out. And generally, whenever any weight of any substance is burnt, and the same products of combustion are formed, a constant amount of heat is evolved. The quantity of heat given out when 1 gram of a substance is burnt is called *heat of combustion*, or calorific power. The amount of heat is measured, as usual, in heat-units. Thus, to say that the calorific power of carbon is 8080, is to say

that 1 gram of carbon in burning gives out enough heat to raise 8080 grams of water from 0° to 1°.

(6) Very inert. The ends of posts are often charred before they are placed in the ground, as they are thus less likely to rot. The interior of wine-casks is sometimes treated in the same way. This form of carbon is a good conductor of electricity.

Charcoal has the power of absorbing gases. Fill a tube with dry ammonia gas over mercury. Heat a small piece of charcoal to redness, so as to drive from it air and moisture. Plunge it while still aglow under the mercury. Keep it there for a few moments, and then let it pass up into the ammonia. The volume of that gas is found to diminish.

1 volume of boxwood charcoal at 15° and 760 mm. takes up 90 vols. ammonia.
Ditto ... ... 85 vols. hydrogen chloride.
Ditto ... ... 9½ „ oxygen.
Ditto ... ... 1½ „ hydrogen.

As a consequence of this power, charcoal is a good disinfectant. It absorbs harmful gases, and within its pores they are brought into such close relationship to the oxygen of the air that they are oxidised, and their ill qualities lost.

Arrange an apparatus as in Fig. 34, where *t* is a thermo-

Fig. 34.

meter dipping into a quantity of wood-charcoal in the flask, and *a* is a delivery tube coming from another apparatus (not shown in the figure), for cooling sulphuretted hydrogen gas (see hereafter), and *c* is cotton wool. A rise of temperature occurs. Wait until that rise of temperature has ceased, and the original temperature of the charcoal before the introduction of the sulphuretted hydrogen is again attained. Turn the charcoal into a beaker, and plunge the thermometer in it. Another rise of temperature occurs, and the ill odour of the sulphuretted hydrogen disappears, as the gas is burning, by uniting with the oxygen in the pores of the charcoal.

The properties given above apply to both kinds of charcoal. But animal charcoal, in addition, has the power of adhering to vegetable colour matters. Place in a flask some animal charcoal, and a little litmus solution, or a little port-wine. Boil the mixture. Then pour the contents of the flask on a filter. The liquid that comes through is colourless. The action of the charcoal is as it was in the experiment with sulphuretted hydrogen. The vegetable colour matters are oxidised, and lose their normal properties.

Exercises on Carbon (*solved*).

89. 40 grams of diamond, 20 of graphite, and 24 of charcoal are all burnt. What weight of carbon dioxide is formed?

12 grams C form 44 grams CO^2
1 gram „ forms $\frac{44}{12}$ „ „
84 grams „ form $\frac{44\times84}{12}$ „ „ = 308 grams.

90. Required 560 cc. carbon dioxide: temperature 13°, pressure 741 mm. What weight of carbon must be burnt?

273 vols. at 0° become 286 at 13°
286 „ „ 13° „ 273 „ 0°
1 vol. „ „ „ $\frac{273}{286}$ „ „
560 vols. „ „ „ $\frac{273\times560}{286}$ „ „

Under pressure 760, volume $=\frac{273\times560}{286}$

1, „ $=\frac{273\times560\times760}{286}$

741, „ $=\frac{273\times560\times760}{286\times741}$

$2\times11{\cdot}2$ litres CO^2 need 12 grams C.
1 litre „ needs $\frac{12}{2\times11{\cdot}2}$ „ „

$\frac{273\times560\times760}{286\times741}$ „ $\frac{12\times273\times560\times760}{2\times11{\cdot}2\times286\times741}$ = 293$\frac{8}{11}$ grams.

91. How many heat units are given out in the production of 22 grams of carbon dioxide?

44 grams CO^2 need 12 grams C.
1 gram „ needs $\frac{12}{44}$ „
22 grams „ need $\frac{12\times22}{44}$ „

1 gram C gives out 8080 heat-units.

$\frac{12\times22}{44}$ give „ $\frac{8080\times12\times22}{44}$ = 48480 heat units.

92. A piece of box-wood charcoal, 3 cm. by 2 cm. by 1 cm., is used to absorb ammonia. What volume of gas is taken up?

$3\times2\times1$ = volume of charcoal in cc.
1 cc. charcoal absorbs 90 cc. ammonia.
$3\times2\times1$ „ „ $90\times3\times2\times1$ = 540 cc.

(*To be continued.*)

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How to Teach Drawing in Elementary Schools.

BY T. R. ABLETT,
Superintendent of Drawing to the School Board for London.

DRAWING FROM MODELS.—III.

The drawing of a simple cupboard will be an easy step forward from the drawing of the map-sheet, door, blackboard, and other simple planes.

Fig. 13 gives the sketch and complete drawing of such a cupboard as may be found in most schools. It has lines above and below the level of the eye, and the vertical planes ABDF and ABCE may be dealt with just in the same way as the door, Fig. 6. In the large drawing, details have been put in which require careful attention.

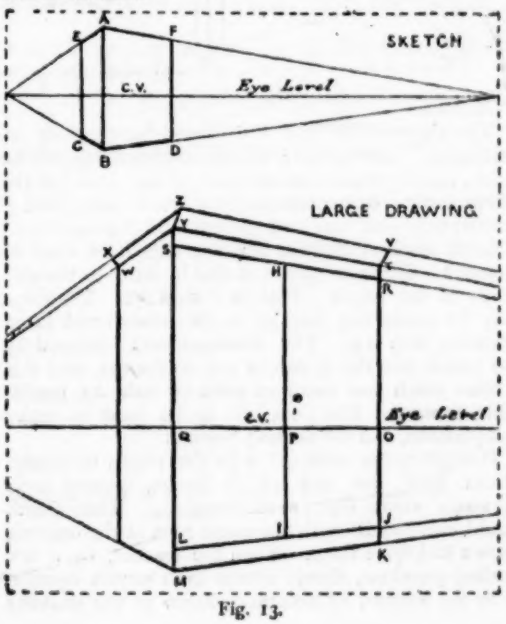


Fig. 13.

The distance SY should be compared with TR by measuring with the pencil, also LM with JK. The teacher should elicit from the pupils the fact that TR appears less than SY, and that JK appears less than LM, and that the lines YT, SR, LJ, MK appear to converge to the same point on the eye-level.

The distance QP should be compared, by measuring, with PO in order that the line HI may be accurately placed.

To obtain the position of Z accurately requires some care. The pencil should be held vertically along line SM. It should be noted whether Z appears on the right-hand or the left-hand side of the pencil, or whether it is hidden by it. Then the distance ZY should be measured and compared with YS by revolving the pencil. When the position of Z has been fixed, the lines ZX, ZV should be drawn. As they are actually parallel to others already drawn they will present little difficulty.

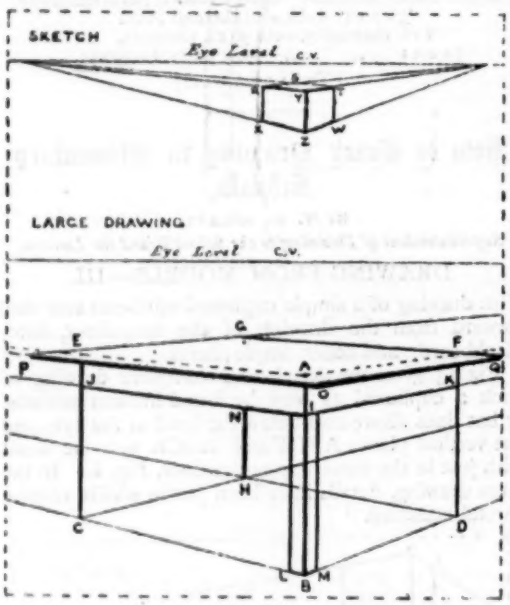


Fig. 14.

The slope of XW and VT should be carefully ascertained. Lastly, a few test measurements should be made, and a general survey taken of the 'look' of the whole thing. Measurement is a great help, but if entirely relied on, may lead to great want of proportion.

Some teachers suppose that the pencil is used to measure a distance upon a model in order to transfer it on to the paper. This is a mistake. Drawings may be made any size, as in the sketch and large drawing, Fig. 13. The measurements obtained by the pencil give the apparent size to the eye, and this is often much too small in scale to make an intelligible drawing. The pencil is to be used to make comparisons, and for nothing beyond.

It might prove serviceable for the pupils to change places near the end of a lesson, leaving their drawings where they were executed. Thus Smith would move to Brown's place and look at the drawing Brown had done there. Then the teacher, by a few leading questions, should obtain each pupil's opinion as to the amount of accuracy shown in the drawing before him. Faults should be lightly marked with a cross and corrected by the owner when he returns to his place.

The drawing of a simple table will be a step in advance of that of a cupboard, as a horizontal plane has to be dealt with as well as vertical planes. Fig. 14 gives sketch and large drawing of a plain table.

In the sketch Z should first be fixed, and ZY drawn in proper proportion. The planes RYZX, YZWT, RYTS should then be obtained as shown in previous lessons.

In the large drawing, the lines IJ and IK will be obtained as SR and LJ were in the drawing of the cupboard. The position of H will be obtained by the intersection of the lines from D and C. Unless the drawing has been, so far, accurate the length of HN will be wrong in proportion when compared with IB.

The position of the point O, which is the projecting corner of the table, will be as difficult to fix correctly as point Z in the cupboard. With O accurately placed P and Q will be easily fixed. The legs may be represented by one line as JC. If the thickness is represented as at L and M, great care must be taken that LB and BM run in the right direction. Very often pupils do not take into account the fact that such short lines as these are parallel to longer lines, such as those forming the edge of the table, and that they appear to converge to the same point.

Legs which are made ornamental in the lathe are much too difficult to be attempted at the present stage. They should be represented by a single straight line or by two lines to indicate their thickness.

Many straight-lined objects are to be found in elementary schools which afford excellent practice, as, for example, a ladder, fireplace, plain chair, swing slate, desk, form, blackboard and easel, side of room with doors and windows, corridor or passage, and the like. In summer the playground affords excellent examples in the parallel bars, covered playground, flight of steps, etc. I have seen several good drawings made of the school buildings themselves.

As it is customary to give cubes, prisms, and pyramids as examination tests it will be necessary to give some special instruction in the drawing of them.

The cube presents no difficulty that has not been overcome in the lessons already considered.

The triangles or polygons which figure in some pyramids and prisms are the most difficult drawing in those models.

To illustrate the way in which they may be dealt with, a description of a method of teaching the model drawing of a hexagon is given below.

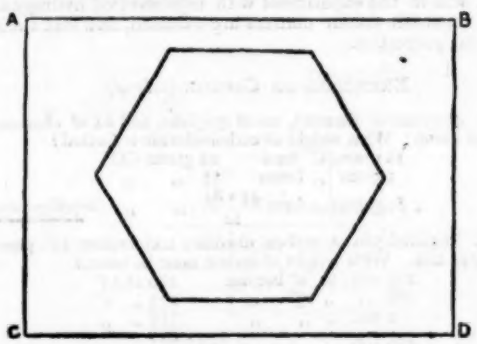


Fig. 15.

In Fig 15, ABCD represent a blackboard with a hexagon three feet in diameter drawn in chalk upon it. The real shape of the hexagon should be copied by the pupils when the blackboard is in its usual position upon the easel. When this has been done, the blackboard should be placed horizontally, and the hexagon drawn as it appears in the new position, that is, something after the fashion shown in Fig 16.

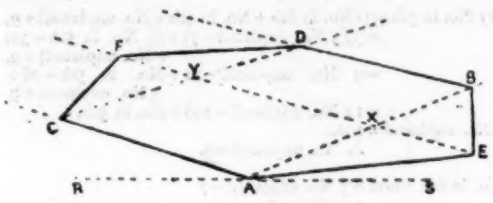


Fig. 16.

Point A should first be fixed and the line AB then drawn with great care as it is very important. The pencil held horizontally, that is as RS, will show the angle RAC. Draw AC. Then BD being actually parallel to it will appear to converge to the same point on the eye-level. FE should also be drawn to that point, for it is really parallel to AC and BD. Point C should be fixed after measuring AB on the pencil and comparing its apparent length with that of AC by revolving the pencil. Draw line CD. CD and AB are really parallel, but appear to converge. Ascertain the direction of BE by holding the pencil vertically. Mark E. Make distance from Y to F rather less than XE. Draw the lines BE, EA, FC, FD. As a test of accurate drawing, measure distance AD, and compare it with distance CB. Also hold the pencil vertically from A, and notice where D comes in relation to it.

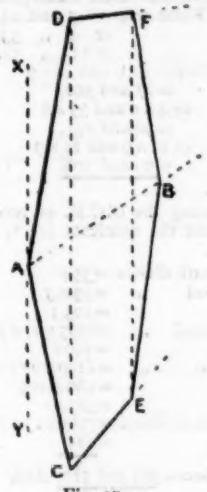


Fig. 17.

Fig. 17 represents a drawing of a hexagon when the blackboard is placed on an easel against a side wall so that point A is much nearer to the pupils than point B. First draw DC. Ascertain the direction of CE carefully. DF, AB appear to converge to the same point on the eye level as CE. Hold the pencil in the position XY, that is, vertically, and note the angles XAD, YAC. Mark points A and B. Measure the distance AB and compare it with CD.

In the next article, the model drawing of simple curved forms will be considered.

Query Column.

RULES.

1. Each correspondent is restricted to *one question.* We should be much obliged if correspondents, who send questions for solution, would give (if possible) the required answer, and the source from which the question is obtained.

2. No query can be answered unless accompanied by the real name and address of the sender, not necessarily for publication, but as a guarantee of good faith and for facility of reference.

3. ☞ When a pseudonym is adopted it should be written at the end of the query, and the real name and address on a separate piece of paper.

4. Correspondents are requested to write their queries *legibly*, and on one side of the paper only.

5. Replies will not be sent through the post.

6. Queries must reach the office *not later than the 12th of the month*, or they cannot be attended to in the following issue.

*** All communications for this column should be addressed—'*The Query Editor*,' *The Practical Teacher, Pilgrim Street, Ludgate Hill, London, E.C.*

Arithmetic.

1. Only.—Simplify:—

$$\frac{\frac{1}{2}-\frac{1}{3}\times(\frac{1}{2}-\frac{1}{3})\times\frac{2}{3}\times(\frac{1}{2}+\frac{1}{3})}{\frac{2}{3}\times(\frac{1}{2}-\frac{1}{3})-\frac{1}{3}\times(\frac{1}{2}-\frac{1}{10})}\cdot \text{ (Ricks.)}$$

$$\frac{\frac{1}{2}-\frac{1}{3}\times(\frac{1}{2}-\frac{1}{3})\times\frac{2}{3}\times(\frac{1}{2}+\frac{1}{3})}{\frac{2}{3}\times(\frac{1}{2}-\frac{1}{3})-\frac{1}{3}\times(\frac{1}{2}-\frac{1}{10})}$$

$$=\frac{\frac{1}{2}-\frac{1}{3}\times\frac{4-3}{6}\times\frac{2}{3}\times\frac{8+5}{10}}{\frac{2}{3}\times\frac{7-4}{8}-\frac{1}{3}\times\frac{10-7}{70}}$$

$$=\frac{\frac{1}{2}-\frac{1}{3}\times\frac{1}{6}\times\frac{6}{7}\times\frac{13}{10}}{\frac{2}{3}\times\frac{3}{8}-\frac{1}{3}\times\frac{3}{70}}$$

$$=\frac{\frac{1}{2}-\frac{13}{210}}{\frac{1}{4}-\frac{1}{70}}$$

$$=\frac{350-39}{315-16}$$

$$=\frac{420}{1120}$$

$$=\frac{\cancel{420}\ 3}{\cancel{1120}\ 8}$$

$$=\frac{3}{8}$$

$$=2\frac{3}{8}\frac{1}{1}. \text{ Ans.}$$

2. Ever.—Find two numbers whose G.C.M. is 9, and L.C.M. is 1188.

$1188 \div 9 = 132$.

We require two prime numbers whose product is 132;

These are, 3 and 44,
or 4 ,, 33,
or 11 ,, 12.

∴ The two numbers $= 3 \times 9$ and 44×9
$= 27$ and 396,
or 4×9 and 33×9
$= 36$ and 297,
or 11×9 and 12×9
$= 99$ and 108.

3. Lily.—In finding the G.C.M. of two numbers, the last remainder is 35, and the quotients are 1, 2, 1, 3; find the numbers. (*Ricks*).

Fourth divisor $= 35$;
Third ,, $= 35 \times 3$
$= 105$;
Second ,, $= (105 \times 1) + 35$
$= 140$;
First ,, $= (140 \times 2) + 105$
$= 280 + 105$
$= 385$;
First dividend $= (385 \times 1) + 140$
$= 525$.

∴ The two numbers $= 385$ and 525. Ans.

4. Mabel.—In the working of an exercise to find the G.C.M. of two numbers, the remainders are 3552 and 888, and the quotients are 2 and 4; what are the numbers? (*Ricks*).

Second divisor $= 3,552$;
First ,, $= (3,552 \times 4) + 888$
$= 14,208 + 888$
$= 15,096$;
First dividend $= (15,096 \times 2) + 3,552$
$= 30,192 + 3,552$
$= 33,744$.

∴ The two numbers $= 15,096$ and $33,744$. Ans.

5. Pupil Teacher.—If $\frac{4}{5}$ of the difference between a certain fraction and $\frac{4}{7}$ lie between $1\frac{1}{15}$ and $1\frac{1}{3}$, find between what limits the fraction itself must lie. (*Lower Division*, May, 1883.)

Limits of difference $= (1\frac{1}{15} \times \frac{5}{4})$ and $(1\frac{1}{3} \times \frac{5}{4})$

$= \left(\frac{16}{15} \times \frac{5}{4}\right)$ and $(\frac{4}{3} \times \frac{5}{4})$

$= \frac{4}{3}$ and $\frac{5}{3}$;

∴ Limits of fraction $= (\frac{4}{7} + \frac{4}{7})$ and $(\frac{5}{7} + \frac{4}{7})$
$= 2$ and $2\frac{1}{7}$. Ans.

6. Dale.—The diameter of the 2nd of 3 pipes is to that of the 1st in the ratio of 4 to 3; find the ratio of the diameter of the 3rd to that of the 2nd, if the water which will flow through all the three in 9 minutes is 50 times as much as will flow through the 1st alone in 1 minute, it being assumed that the quantity of water flowing through any pipe varies as the square of its diameter.

Let D stand for the Diameter;

Then, (D of 1st)^2 + (D of 2nd)^2 + (D of 3rd)^2
$= \frac{9}{16}$ (D of 1st)^2,

$(\frac{3}{4}$ D of 2nd)^2 + (D of 2nd)^2 + (D of 3rd)^2
$= \frac{9}{16}(\frac{3}{4}$ D of 2nd)^2,

$\frac{9}{16}$(D of 2nd)^2 + (D of 2nd)^2 + (D of 3rd)^2
$= \frac{9}{16} \times \frac{9}{16}$(D of 2nd)^2,

$\frac{81}{256}$(D of 2nd)^2 + (D of 3rd)^2 = $\frac{81}{256}$(D of 2nd)^2,

(D of 3rd)^2 = $(\frac{81}{256} - \frac{81}{256})$(D of 2nd)^2
$= \frac{81}{256}$(D of 2nd)^2,

∴ D of 3rd = $\frac{9}{16}$ D of 2nd;

Wherefore, Diameter of 3rd : Diameter of 2nd :: 5 : 4. Ans.

7. Owen Tudor.—In the upper school at Eton College on Election Saturday, 1866, there were 745 boys. The number of boys in the 5th Form exceeded three times the sum of the number of unplaced boys and of those in the 6th and 4th Forms by 9. The number in the 6th Form equalled 3 times the number of unplaced boys less 7. The number in the 4th Form equalled $\frac{1}{3}$ of the number in the 5th less 32. Find the number of boys in the 6th, 5th, and 4th Forms respectively, and the number of unplaced boys.

In the lower school one boy was unplaced, and the difference between the number of those in the 3rd Form and 1st Form equalled 11 times the difference between the number of those in the 2nd Form and the unplaced. Also the number in the 3rd Form equalled 9 times the sum of the numbers in the 2nd Form and the unplaced. Also the number in the 2nd Form equalled twice the number in the 1st Form. Find the number of boys in the lower school. (*Barnard Smith's* 'Examination Papers.')

(1) No. in 5th $= 3$(No. in 6th + No. in 4th + No. unplaced) + 9,
$= 3\{(3$ No. unplaced $- 7) + (\frac{1}{3}$ No. in 5th $- 32)$
$+$ No. unplaced$\} + 9$,
$= 9$ No. unplaced $- 21 +$ No. in 5th $- 96 +$
3 No. unplaced $+ 9$,
$= 12$ No. unplaced $- 108 +$ No. in 5th,

12 No. unplaced $= 108$,

∴ No. unplaced $= 9$.

No. in 6th Form $= 3$ No. unplaced $- 7$
$= (3 \times 9) - 7$
$= 20$;

No. in 6th + No. in 5th + No. in 4th + No. unplaced $= 745$,
$20 +$ No. in 5th $+ (\frac{1}{3}$ No. in 5th $- 32) + 9 = 745$,
$29 +$ No. in 5th $+ \frac{1}{3}$ No. in 5th $- 32 = 745$,
$\frac{4}{3}$ No. in 5th $- 3 = 745$,
$\frac{4}{3}$ No. in 5th $= 748$,
187
∴ No. in 5th Form $= \frac{748}{4} \times 3$
$= 561$.

No. in 4th Form $= \frac{1}{3}$ No. in 5th $- 32$
$= \frac{561}{3} - 32$
$= 187 - 32$
$= 155$.

(2) No. in 3rd − No. in 1st $= 11$(No. in 2nd − No. unplaced),
9(No. in 2nd + No. unplaced) − No. in 1st
$= 11$(No. in 2nd − 1),
9 No. in 2nd + 9 − No. in 1st $= 11$ No. in 2nd − 11,
11 No. in 2nd − 9 No. in 2nd + No. in 1st $= 9 + 11$,
2 No. in 2nd + No. in 1st $= 20$,
4 No. in 1st + No. in 1st $= 20$,
5 No. in 1st $= 20$,
∴ No. in 1st Form $= 4$.

No. in 2nd Form $= 8$;
,, 3rd ,, $= 9$ (No. in 2nd + No. unplaced)
$= 9\ (8 + 1)$
$= 81$;
∴ No. of boys in th lower school
$= 81 + 8 + 4 + 1$
$= 94$. Ans.

8. Scribbler.—Explain the following quotation from the *Times* of November 29th:—'Consols opened this morning at a fresh decline of an eighth, and ultimately experienced a further fall. The first bargains were at $89\frac{3}{8}$ to $\frac{1}{2}$, and the last at $89\frac{1}{4}$ to $\frac{3}{8}$. For the 7th of December the final quotation was $87\frac{7}{8}$ to 88 ex. div.' (*Watt's* 'Pupil Teachers' Test Cards.')

At the commencement of business the price of consols was £$\frac{1}{8}$ less than closing price on previous day, and the price still further declined. Prices at the commencement were from £$89\frac{3}{8}$ to £$89\frac{1}{2}$, and at the close of business were from £$89\frac{1}{4}$ sellers to £$89\frac{3}{8}$ buyers. Those who bought and sold not for cash but for settlement on the 7th of December did so at £88 and £$87\frac{7}{8}$ respectively.

9. Mary Chitty.—Which is the better investment, £1,896 in the $3\frac{1}{2}$ per cents. at 87, or in railway shares at £89 per share, the dividends in the latter case being $3\frac{1}{2}$ per cent. on the sum invested?

Income on £1 in 1st case $= £\frac{3\frac{1}{2}}{87}$
$= £\frac{7}{174}$;
,, ,, ,, 2nd ,, $= £\frac{3\frac{1}{2}}{89}$
$= £\frac{7}{178}$;
∴ 1st investment : 2nd investment :: $\frac{7}{174} : \frac{7}{178}$,
:: 2492 : 2610.

∴ Second is the better investment.

10. C. B. ELLISON.—A fraction, which, when reduced to a decimal, consists of two non-repeating figures followed by $\dot{7}8\dot{3}$, has 148 for its denominator, and the numerator is $\frac{3}{4}$ of the number expressed by the non-repeating figures; find the numerator of the fraction. (*Lower Division Civil Service Paper*, May, 1885.)

Denominator of fraction before it is reduced to its lowest terms = 99900;

$99900 \div 148 = 675$;

∴ Numerator is divisible by 675;

Of the two non-repeating figures the right-hand one must be *even*, as the number expressed by those two figures is divisible by 2; and when it is subtracted from the end figure of the recurring part, it must leave 5, and therefore the right-hand figure of the non-repeating figures is 8.

The next figure in the subtraction must be 2 or 7, as the remainder is divisible by 675, and therefore the other figure is 5.

$$\begin{aligned} &\cdot 58\dot{7}8\dot{3} \\ &= \frac{58783 - 58}{99900} \\ &= \frac{58725}{99900} \\ &= \frac{87}{148}; \end{aligned}$$

∴ Numerator of fraction = 87. Ans.

11. CORNET.—The number of passengers in the second-class carriage of a train was three times the number in the first-class, and the number in the third class exceeded the other two together by 36; the fares for the several classes were at the rate of 3d., 2d., and 1d. per mile; the average distance travelled by each of the first-class passengers was 120 miles, by each of the second-class 50 miles, and by each of the third class 25 miles, and the whole fares amounted to £390 1s. 8d.; how many passengers were there of each class? (*Men Clerkships*, May, 1885.)

$\{(3d. \times 120) + (2d. \times 50 \times 3) + (1d. \times 25 \times 4)\} \times$ No. of 1st class passengers $= £390\ 1s.\ 8d. - (1d. \times 25 \times 36)$,

$(360d. + 300d. + 100d.) \times$ No. of 1st class passengers $= 93{,}620d. - 900d.$,

$760d. \times$ No. of 1st class passengers $= 92{,}720d.$,

∴ No. of 1st class passengers $= \frac{92720d.}{760d.}$

$= 122$;

" 2nd " " $= 122 \times 3$

$= 366$;

" 3rd " " $= 122 + 366 + 36$

$= 524.$

12. ATTILA.—(1) If 3 men, 5 women, or 8 children, could do a quantity of work in $26\frac{1}{2}$ hours, in what time would 2 men, 3 women, and 4 children complete it?

(2) The sum of £3 13s. 6d. is to be divided among 21 men, 21 women, and 21 children, so that a woman may have as much as two children, and a man as much as a woman and a child; what will each man, woman, and child receive? (*Colenso.*)

(1) 3 men can do as much as 8 children,

∴ 2 " " " $\frac{8 \times 2}{3}$ "

$= 5\frac{1}{3}$ children;

5 women can do as much as 8 children,

∴ 3 " " " $\frac{8 \times 3}{5}$ "

$= 4\frac{4}{5}$ children;

∴ 2 men, 3 women, and 4 children can do as much as $(5\frac{1}{3} + 4\frac{4}{5} + 4)$ children

$= 14\frac{2}{15}$ children.

children		children		hours
$14\frac{2}{15}$	:	8	::	$26\frac{1}{2}$: Time.

$$= \left(\frac{8}{1} \times \frac{53}{2} \times \frac{15}{212}\right) \text{ hours.}$$

$= 15$ hours. Ans.

(2) Child's share $= £3\ 13s.\ 6d. \div \{(1 + 2 + 3) \times 21\}$

$= £3\ 13s.\ 6d. \div (6 \times 21)$

$= 12s.\ 3d. \div 21$

$= 7d.$

Woman's share $= 7d. \times 2 = 1s.\ 2d.$;

Man's " $= 7d. \times 3 = 1s.\ 9d.$

Algebra.

1. BEWILDERED.—Solve (with explanation):—

$\sqrt{x+14} + \sqrt{x-14} = 14$.—(*Todhunter's* 'Algebra for Beginners.')

$$\sqrt{x+14} + \sqrt{x-14} = 14$$

Squaring each side: $x + 14 + 2\sqrt{(x+14)(x-14)} + x - 14 = 196$

Dividing each term by 2: $2x + 2\sqrt{x^2 - 196} = 196$

Transposing: $x + \sqrt{x^2 - 196} = 98$

Transposing: $x - 98 = -\sqrt{x^2 - 196}$

Squaring each side: $x^2 - 196x + 9604 = x^2 - 196$

$-196x = -196 - 9604$

$196x = 9800$

∴ $x = 50$.

2. MARK TWAIN.—The difference of two sums of money is £203 10s.; the greater is payable at the end of 8 months, and the less at the end of 7 months; and if the use of money were valued at $3\frac{1}{2}$ per cent. per annum for the greater sum, and $4\frac{1}{2}$ per cent. for the less, the joint amount of their discounts would be £24 10s.; required each sum. (*Colenso.*)

$$£3\tfrac{1}{2} \times \tfrac{8}{12} = \left(\frac{7}{2} \times \frac{x}{3}\right) £ = £2\tfrac{1}{3};$$

$$£4\tfrac{1}{2} \times \tfrac{7}{12} = \left(\frac{9}{2} \times \frac{7}{12}\right) £ = £2\tfrac{5}{8}.$$

Let x = greater sum in pounds,

And " y = less " " ;

Then, (1) $x - y = 203\frac{1}{2}$

(2) $\left(x \times \frac{2\frac{1}{3}}{102\frac{1}{2}}\right) + \left(y \times \frac{2\frac{5}{8}}{102\frac{1}{2}}\right) = 24\frac{1}{2}$

(2) $(x \times \frac{7}{307}) + (y \times \frac{21}{821}) = \frac{49}{2}$

Dividing each term by 7: $\frac{x}{307} + \frac{3y}{821} = \frac{7}{2}$

Multiplying each term by 307: $x + \frac{921y}{821} = \frac{2149}{2}$

(1) $x - y = \frac{407}{2}$

Subtracting: $\frac{1742y}{821} = \frac{1742}{2}$

$\frac{y}{821} = \frac{1}{2}$

∴ $y = \frac{821}{2}$

$= 410\frac{1}{2}$.

(1) $x - y = 203\frac{1}{2}$

∴ $x = 203\frac{1}{2} + 410\frac{1}{2}$

$= 614$.

∴ Greater sum = £614,

Less " = £410 10s. } Ans.

3. NOBODY.—By selling a horse for £24 I lose as much per cent. as it cost me. What was the prime cost?

Let x = cost of horse in pounds;

Then, $x - \left(x \times \frac{x}{100}\right) = 24$

$$x - \frac{x^2}{100} = 24$$

$x^2 - 100x = -2400$

$x^2 - 100x + (50)^2 = 2500 - 2400$

$= 100$

$x - 50 = \pm 10$

$x = 50 \pm 10$

∴ $x = 60$, or 40.

∴ Cost of horse = £60, or £40. Ans.

4. CIVIS.—The apparent intensity of a light varies inversely as the square of its distance; find the point (1) between two lamps 50 yards apart, (2) in a straight line beyond one of them, at which one appears twice as bright as the other. (*Civil Service Candidate.*)

2. Ever.—Find two numbers whose G.C.M. is 9, and L.C.M. is 1188.

$1188 \div 9 = 132$.

We require two prime numbers whose product is 132;

These are, 3 and 44,
or 4 ,, 33,
or 11 ,, 12.

∴ The two numbers $= 3 \times 9$ and 44×9
$= 27$ and 396,
or 4×9 and 33×9
$= 36$ and 297,
or 11×9 and 12×9
$= 99$ and 108.

3. Lily.—In finding the G.C.M. of two numbers, the last remainder is 35, and the quotients are 1, 2, 1, 3; find the numbers. (*Ricks*).

Fourth divisor $= 35$;
Third ,, $= 35 \times 3$
$= 105$;
Second ,, $= (105 \times 1) + 35$
$= 140$;
First ,, $= (140 \times 2) + 105$
$= 280 + 105$
$= 385$;
First dividend $= (385 \times 1) + 140$
$= 525$.

∴ The two numbers $= 385$ and 525. Ans.

4. Mabel.—In the working of an exercise to find the G.C.M. of two numbers, the remainders are 3552 and 888, and the quotients are 2 and 4; what are the numbers? (*Ricks*).

Second divisor $= 3,552$;
First ,, $= (3,552 \times 4) + 888$
$= 14,208 + 888$
$= 15,096$;
First dividend $= (15,096 \times 2) + 3,552$
$= 30,192 + 3,552$
$= 33,744$.

∴ The two numbers $= 15,096$ and 33,744. Ans.

5. Pupil Teacher.—If $\frac{4}{7}$ of the difference between a certain fraction and $\frac{3}{5}$ lie between $1\frac{1}{12}$ and $1\frac{1}{4}$, find between what limits the fraction itself must lie. (*Lower Division*, May, 1883.)

Limits of difference $= (1\frac{1}{12} \times \frac{7}{4})$ and $(1\frac{1}{4} \times \frac{7}{4})$

$= \left(\frac{\cancel{19}^{4}}{\cancel{12}_{3}} \times \frac{7}{\cancel{4}}\right)$ and $(\frac{5}{4} \times \frac{7}{4})$

$= \frac{7}{3}$ and $\frac{35}{16}$;

∴ Limits of fraction $= (\frac{7}{3} + \frac{3}{5})$ and $(\frac{35}{16} + \frac{3}{5})$
$= 2$ and $2\frac{1}{16}$. Ans.

6. Dale.—The diameter of the 2nd of 3 pipes is to that of the 1st in the ratio of 4 to 3; find the ratio of the diameter of the 3rd to that of the 2nd, if the water which will flow through all the three in 9 minutes is 50 times as much as will flow through the 1st alone in 1 minute, it being assumed that the quantity of water flowing through any pipe varies as the square of its diameter.

Let D stand for the Diameter;

Then, (D of 1st)^2 + (D of 2nd)^2 + (D of 3rd)^2
$= \frac{9}{25}$ (D of 1st)^2,

$(\frac{3}{4}$ D of 2nd)^2 + (D of 2nd)^2 + (D of 3rd)^2
$= \frac{25}{16}(\frac{3}{4}$ D of 2nd)^2,

$1\frac{9}{16}$(D of 2nd)^2 + (D of 2nd)^2 + (D of 3rd)^2
$= \frac{25}{16} \times 1\frac{9}{16}$(D of 2nd)^2,

$\frac{25}{16}$(D of 2nd)^2 + (D of 3rd)^2 = $\frac{25}{16}$(D of 2nd)^2,

(D of 3rd)^2 = $(\frac{25}{16} - \frac{25}{16})$(D of 2nd)^2
$= \frac{9}{16}$(D of 2nd)^2,

∴ D of 3rd = $\frac{3}{4}$ D of 2nd;

Wherefore, Diameter of 3rd : Diameter of 2nd :: 5 : 4. Ans.

7. Owen Tudor.—In the upper school at Eton College on Election Saturday, 1866, there were 745 boys. The number of boys in the 5th Form exceeded three times the sum of the number of unplaced boys and of those in the 6th and 4th Forms by 9. The number in the 6th Form equalled 3 times the number of unplaced boys less 7. The number in the 4th Form equalled $\frac{1}{3}$ of the number in the 5th less 32. Find the number of boys in the 6th, 5th, and 4th Forms respectively, and the number of unplaced boys.

In the lower school one boy was unplaced, and the difference between the number of those in the 3rd Form and 1st Form equalled 11 times the difference between the number of those in the 2nd Form and the unplaced. Also the number in the 3rd Form equalled 9 times the sum of the numbers in the 2nd Form and the unplaced. Also the number in the 2nd Form equalled twice the number in the 1st Form. Find the number of boys in the lower school. (*Barnard Smith's* 'Examination Papers.')

(1) No. in 5th $= 3$ (No. in 6th + No. in 4th + No. unplaced) + 9,
$= 3\{(3$ No. unplaced $- 7) + (\frac{1}{3}$ No. in 5th $- 32)$
$+$ No. unplaced$\} + 9$,
$= 9$ No. unplaced $- 21 +$ No. in 5th $- 96 +$
3 No. unplaced $+ 9$,
$= 12$ No. unplaced $- 108 +$ No. in 5th,

12 No. unplaced $= 108$,
∴ No. unplaced $= 9$.

No. in 6th Form $= 3$ No. unplaced $- 7$
$= (3 \times 9) - 7$
$= 20$;

No. in 6th + No. in 5th + No. in 4th + No. unplaced $= 745$,
$20 +$ No. in 5th $+ (\frac{1}{3}$ No. in 5th $- 32) + 9 = 745$,
$29 +$ No. in 5th $+ \frac{1}{3}$ No. in 5th $- 32 = 745$,
$\frac{4}{3}$ No. in 5th $- 3 = 745$,
$\frac{4}{3}$ No. in 5th $= 748$,

∴ No. in 5th Form $= \frac{\cancel{748}^{187} \times 3}{\cancel{4}_{1}}$
$= 561$.

No. in 4th Form $= \frac{1}{3}$ No. in 5th $- 32$
$= \frac{1}{3}$ of $561 - 32$
$= 187 - 32$
$= 155$.

(2) No. in 3rd − No. in 1st $= 11$(No. in 2nd − No. unplaced),
9(No. in 2nd + No. unplaced) − No. in 1st
$= 11$(No. in 2nd − 1),
9 No. in 2nd + 9 − No. in 1st $= 11$ No. in 2nd − 11,
11 No. in 2nd − 9 No. in 2nd + No. in 1st $= 9 + 11$,
2 No. in 2nd + No. in 1st $= 20$,
4 No. in 1st + No. in 1st $= 20$,
5 No. in 1st $= 20$,
∴ No. in 1st Form $= 4$.

No. in 2nd Form $= 8$;
,, 3rd ,, $= 9$ (No. in 2nd + No. unplaced)
$= 9\ (8 + 1)$
$= 81$;

∴ No. of boys in th lower school
$= 81 + 8 + 4 + 1$
$= 94$. Ans.

8. Scribbler.—Explain the following quotation from the *Times* of November 29th :—'Consols opened this morning at a fresh decline of an eighth, and ultimately experienced a further fall. The first bargains were at $89\frac{3}{8}$ to $\frac{1}{2}$, and the last at $89\frac{1}{4}$ to $\frac{3}{8}$. For the 7th of December the final quotation was $87\frac{7}{8}$ to 88 ex. div.' (*Moffat's* 'Pupil Teachers' Test Cards.')

At the commencement of business the price of conso's was $\frac{1}{8}$ less than closing price on previous day, and the price still further declined. Prices at the commencement were from $89\frac{3}{8}$ to $89\frac{1}{2}$, and at the close of business were from $89\frac{1}{4}$ sellers to $89\frac{3}{8}$ buyers. Those who bought and sold not for cash but for settlement on the 7th of December did so at £88 and $87\frac{7}{8}$ respectively.

9. Mary Chitty.—Which is the better investment, £1,896 in the $3\frac{1}{2}$ per cents. at 87, or in railway shares at £89 per share, the dividends in the latter case being $3\frac{3}{4}$ per cent. on the sum invested?

Income on £1 in 1st case $= £\frac{3\frac{1}{2}}{87}$
$= £\frac{7}{174}$;

,, ,, ,, 2nd ,, $= £\frac{3\frac{3}{4}}{89}$
$= £\frac{15}{356}$;

∴ 1st investment : 2nd investment :: $\frac{7}{174}$: $\frac{15}{356}$,
:: 2492 : 2610.

∴ Second is the better investment.

10. C. B. Ellison.—A fraction, which, when reduced to a decimal, consists of two non-repeating figures followed by $\dot{7}8\dot{3}$, has 148 for its denominator, and the numerator is $\frac{3}{4}$ of the number expressed by the non-repeating figures; find the numerator of the fraction. (*Lower Division Civil Service Paper*, May, 1885.)

Denominator of fraction before it is reduced to its lowest terms = 99900;

$99900 \div 148 = 675$;

∴ Numerator is divisible by 675;

Of the two non-repeating figures the right-hand one must be *even*, as the number expressed by those two figures is divisible by 2; and when it is subtracted from the end figure of the recurring part, it must leave 5, and therefore the right-hand figure of the non-repeating figures is 8.

The next figure in the subtraction must be 2 or 7, as the remainder is divisible by 675, and therefore the other figure is 5.

$$\begin{aligned} &\cdot 58\dot{7}8\dot{3} \\ &= \frac{58783 - 58}{99900} \\ &= \frac{\overset{87}{\cancel{58725}}}{\underset{1480}{\cancel{99900}}} \\ &= \frac{87}{1480}; \end{aligned}$$

∴ Numerator of fraction = **87.** Ans.

11. Cornet.—The number of passengers in the second-class carriage of a train was three times the number in the first-class, and the number in the third class exceeded the other two together by 36; the fares for the several classes were at the rate of 3d., 2d., and 1d. per mile; the average distance travelled by each of the first-class passengers was 120 miles, by each of the second-class 50 miles, and by each of the third class 25 miles, and the whole fares amounted to £390 1s. 8d.; how many passengers were there of each class? (*Men Clerkships*, May, 1885.)

$\{(3d. \times 120) + (2d. \times 50 \times 3) + (1d. \times 25 \times 4)\} \times$ No. of 1st class passengers $= £390\ 1s.\ 8d. - (1d. \times 25 \times 36)$,

$(360d. + 300d. + 100d.) \times$ No. of 1st class passengers $= 93{,}620d. - 900d.$,

$760d. \times$ No. of 1st class passengers $= 92{,}720d.$,

∴ No. of 1st class passengers $= \frac{92720d.}{760d.}$

$= 122$;

„ 2nd „ „ $= 122 \times 3$

$= 366$;

„ 3rd „ „ $= 122 + 366 + 36$

$= 524.$

12. Attila.—(1) If 3 men, 5 women, or 8 children, could do a quantity of work in $26\frac{1}{2}$ hours, in what time would 2 men, 3 women, and 4 children complete it?

(2) The sum of £3 13s. 6d. is to be divided among 21 men, 21 women, and 21 children, so that a woman may have as much as two children, and a man as much as a woman and a child; what will each man, woman, and child receive? (*Colenso.*)

(1) 3 men can do as much as 8 children,

∴ 2 „ „ „ $\frac{8 \times 2}{3}$ „

$= 5\frac{1}{3}$ children;

5 women can do as much as 8 children,

∴ 3 „ „ „ $\frac{8 \times 3}{5}$ „

$= 4\frac{4}{5}$ children;

∴ 2 men, 3 women, and 4 children can do as much as $(5\frac{1}{3} + 4\frac{4}{5} + 4)$ children

$= 14\frac{2}{15}$ children.

∴ children : children :: hours : Time.

$14\frac{2}{15} : 8 :: 26\frac{1}{2} :$ Time.

$= \left(\frac{\overset{8}{\cancel{8}}}{1} \times \frac{\overset{53}{\cancel{212}}}{\underset{1}{\cancel{15}}} \times \frac{15}{\underset{4}{\cancel{212}}}\right)$ hours.

$= 15$ hours. Ans.

(2) Child's share $= £3\ 13s.\ 6d. \div \{(1+2+3) \times 21\}$

$= £3\ 13s.\ 6d. \div (6 \times 21)$

$= 12s.\ 3d. \div 21$

$= 7d.$

Woman's share $= 7d. \times 2 = 1s.\ 2d.$;

Man's „ $= 7d. \times 3 = 1s.\ 9d.$

Algebra.

1. Bewildered.—Solve (with explanation):—

$\sqrt{x+14} + \sqrt{x-14} = 14$.—(*Todhunter's* 'Algebra for Beginners.')

$$\sqrt{x+14} + \sqrt{x-14} = 14$$

Squaring each side: $x + 14 + 2\sqrt{(x+14)(x-14)} + x - 14 = 196$

$$2x + 2\sqrt{x^2 - 196} = 196$$

Dividing each term by 2: $x + \sqrt{x^2 - 196} = 98$

Transposing: $x - 98 = -\sqrt{x^2 - 196}$

Squaring each side: $x^2 - 196x + 9604 = x^2 - 196$

$$-196x = -196 - 9604$$

$$196x = 9800$$

$$\therefore x = \underline{50}.$$

2. Mark Twain.—The difference of two sums of money is £203 10s.; the greater is payable at the end of 8 months, and the less at the end of 7 months; and if the use of money were valued at $3\frac{1}{2}$ per cent. per annum for the greater sum, and $4\frac{1}{2}$ per cent. for the less, the joint amount of their discounts would be £24 10s.; required each sum. (*Colenso.*)

$$£3\tfrac{1}{2} \times \tfrac{8}{12} = \left(\frac{7}{2} \times \frac{2}{3}\right)£ = £2\tfrac{1}{3};$$

$$£4\tfrac{1}{2} \times \tfrac{7}{12} = \left(\frac{9}{2} \times \frac{7}{12}\right)£ = £2\tfrac{5}{8}.$$

Let x = greater sum in pounds,

And „ y = less „ „ „;

Then, (1) $x - y = 203\frac{1}{2}$

(2) $\left(x \times \frac{2\frac{1}{2}}{102\frac{1}{2}}\right) + \left(y \times \frac{2\frac{5}{8}}{102\frac{5}{8}}\right) = 24\frac{1}{2}$

(2) $(x \times \frac{5}{205}) + (y \times \frac{21}{821}) = \frac{49}{2}$

Dividing each term by 7: $\frac{x}{307} + \frac{3y}{821} = \frac{7}{2}$

Multiplying each term by 307: $x + \frac{921y}{821} = \frac{2149}{2}$

(1) $x - y = \frac{407}{2}$

Subtracting: $\frac{1742y}{821} = \frac{1742}{2}$

$$\frac{y}{821} = \tfrac{1}{2}$$

$$\therefore y = \frac{821}{2}$$

$$= \underline{410\tfrac{1}{2}}.$$

(1) $x - y = 203\frac{1}{2}$

$\therefore x = 203\frac{1}{2} + 410\frac{1}{2}$

$= \underline{614}.$

∴ Greater sum = £614,

Less „ = £410 10s. } Ans.

3. Nobody.—By selling a horse for £24 I lose as much per cent. as it cost me. What was the prime cost?

Let x = cost of horse in pounds;

Then, $x - \left(x \times \frac{x}{100}\right) = 24$

$$x - \frac{x^2}{100} = 24$$

$$x^2 - 100x = -2400$$

$$x^2 - 100x + (50)^2 = 2500 - 2400$$

$$= 100$$

$$x - 50 = \pm 10$$

$$x = 50 \pm 10$$

$$\therefore x = \underline{60, \text{ or } 40}.$$

∴ Cost of horse = £60, or £40. Ans.

4. Civis.—The apparent intensity of a light varies inversely as the square of its distance; find the point (1) between two lamps 50 yards apart, (2) in a straight line beyond one of them, at which one appears twice as bright as the other. (*Civil Service Candidate.*)

(1) Let x = Distance in yds. from one lamp in first case,
Then $50-x=$ " " " " other " " " "
$\therefore x^2 : (50-x)^2 :: 1 : 2$;
That is, $2x^2=(50-x)^2$
$=2,500-100x+x^2$
$x^2+100x=2,500$
$x^2+100x+(50)^2=2,500+2,500$
$=5,000$
$x+50=\pm 70{\cdot}71\ldots$
$x=\pm 70{\cdot}71\ldots-50$
$\therefore x=20{\cdot}71\ldots$, or $-120{\cdot}71\ldots$

$\therefore$ In first case the point is 20·71... yds. from one lamp, and (50 − 20·71...) yds., or 29·29 yds. (nearly) from the other lamp.

(2) Let x = Distance in yds. from one lamp in second case,
Then $50+x=$ " " " " other " " " " ;
$\therefore x^2 : (50+x)^2 :: 1 : 2$;
That is, $2x^2=(50+x)^2$
$=2,500+100x+x^2$
$x^2-100x=2,500$
$x^2-100x+(50)^2=2,500+2,500$
$=5,000$
$x-50=\pm 70{\cdot}71\ldots$
$x=50\pm 70{\cdot}71\ldots$
$\therefore x=120{\cdot}71\ldots$, or $-20{\cdot}71\ldots$

$\therefore$ In second case the point is 120·71... yds. from one lamp and 170·71... yds. from the other lamp.

5. Burrell.—Express 2 feet 10½ inches linear measure, and 5 feet 79½ inches square measure, in the scale of 12 as feet and duodecimals of a foot; and the latter quantity being the area of a rectangle, one of whose sides is the former, find the other side by dividing in the duodenary scale. (*Todhunter.*)

$10\frac{1}{2}$ inches $=\frac{10\frac{1}{2}}{12}$ ft. $=(\frac{1}{1}\frac{0}{2}+\frac{6}{1\,4\,4})$ ft.

Thus 2 ft. 10½ in. $=2{\cdot}\mathcal{E}3$ ft. in the duodenary scale.

$79\frac{1}{2}$ sq. in. $=\frac{79\frac{1}{2}}{144}$ sq. ft. $=(\frac{6}{1\,2}+\frac{7}{1\,4\,4}+\frac{9}{1\,7\,2\,8})$ sq. ft.

Thus 5 sq. ft. 79½ in. = 5·672 sq. ft. in the duodenary scale.

$$2{\cdot}\mathcal{E}3\overline{)5{\cdot}672(1{\cdot}\mathcal{E}4}$$
$$\underline{2\mathcal{E}3}$$
$$2842$$
$$\underline{2749}$$
$$\mathcal{E}50$$
$$\underline{\mathcal{E}50}$$

$\therefore$ The other side of rectangle = 1·$\mathcal{E}$4 feet in duodenary scale
= 1 ft. 11½ in. denary "
= 23½ in. Ans.

6. Anacolontha.—The reversion, after 2 years, of a freehold worth £168 2s. a year is to be sold; find its present value, supposing interest at 2½ per cent.

Let P denote the present value of the freehold in pounds; A the annual value; R the amount of one pound in one year; and n the number of years at the end of which the reversion commences.

$$\text{Then, } P=\frac{AR^{-n}}{R-1}$$
$$=\frac{168{\cdot}1\times(\frac{4\,1}{4\,0})^{-2}}{\frac{4\,1}{4\,0}-1}$$
$$=168{\cdot}1\times(\tfrac{4\,0}{4\,1})^2\times 40$$
$$=\frac{168{\cdot}1\times(40)^3}{1681}$$
$$=6{,}400.$$

$\therefore$ Present value = £6,400. Ans.

7. Chuzzlewit.—Supposing an annuity to continue for ever to be worth 25 years' purchase, find the annuity to continue for three years which can be purchased for £625. (*Todhunter.*)

Let P denote the present value of the annuity in pounds; A the amount of the annuity; R the amount of one pound in one year; and n the number of years; also, let r denote the interest of one pound for one year.

Since an annuity to continue for ever is worth 25 years' purchase,

$$\therefore 25=\frac{1}{r}, \text{ wherefore } r=\tfrac{1}{2\,5}.$$

$$\text{Now, } P=\frac{A(1-R^{-n})}{R-1}$$
$$625=\frac{A\{1-(\frac{2\,5}{2\,6})^{-3}\}}{\frac{2\,6}{2\,5}-1}$$
$$=A\{1-(\tfrac{2\,5}{2\,6})^3\}\times 25$$
$$25=A\left\{\frac{(26)^3-(25)^3}{(26)^3}\right\}$$
$$=A\frac{17576-15625}{17576}$$
$$A\times 1951=25\times 17576$$
$$\therefore A=\frac{4\,3\,9\,4\,0\,0}{1\,9\,5\,1}$$
$$=225\tfrac{4\,2\,5}{1\,9\,5\,1}.$$

$\therefore$ Annuity = £225 4s. $4\frac{4\,2\,5}{1\,9\,5\,1}$d. Ans.

8. Solicitor.—A sum of £1,000 is lent to be repaid with interest at 4 per cent. by annual instalments, beginning with £40 at the end of the first year, and increasing 30 per cent. each year on the last preceding instalment. Find when the debt will be paid off, having given

log 2 = ·30103, log 3 = ·47712. (*Todhunter.*)

Let P denote the amount in pounds, A the amount of the first payment, R the amount of one pound in one year, n the number of years, and let m stand for $\frac{1\,3\,0}{1\,0\,0}$.

We have to find the present value of **A** due at the end of 1 year, of mA due at the end of 2 years, of m^2A due at the end of 3 years, etc.,

$$\text{Then, } P=\frac{A}{R}+\frac{mA}{R^2}+\frac{m^2A}{R^3}+\ldots+\frac{m^{n-1}A}{R^n}$$
$$=\frac{A}{R}\left(\frac{\frac{m^n}{R^n}-1}{\frac{m}{R}-1}\right);$$

Now in the question, P = 1000, A = 40,

$$R=\tfrac{1\,0\,4}{1\,0\,0},\ \frac{m}{R}=\tfrac{1\,3\,0}{1\,0\,4}=\tfrac{5}{4};$$
$$\therefore 1000=\frac{40}{\frac{1\,0\,4}{1\,0\,0}}\left\{\frac{(\frac{5}{4})^n-1}{\frac{5}{4}-1}\right\}$$
$$=\tfrac{1\,0\,0}{1\,0\,4}\{(\tfrac{5}{4})^n-1\}\times 4$$
$$=\tfrac{1\,0\,0}{2\,6}\{(\tfrac{5}{4})^n-1\}$$
$$1=\tfrac{2}{1\,3}\{(\tfrac{5}{4})^n-1\}$$
$$\tfrac{1\,3}{2}=(\tfrac{5}{4})^n-1$$
$$(\tfrac{5}{4})^n=\tfrac{1\,3}{2}+1$$
$$=\tfrac{1\,5}{2}$$
$$\therefore n=\frac{\log 15-\log 2}{\log 5-\log 4}$$
$$=\frac{\log 5+\log 3-\log 2}{\log 5-2\log 2}$$
$$=\frac{\log \frac{1\,0}{4}+\log 3-\log 2}{\log \frac{1\,0}{4}-2\log 2}$$
$$=\frac{\log 10-\log 2+\log 3-\log 2}{\log 10-\log 2-2\log 2}$$
$$=\frac{\log 10+\log 3-2\log 2}{\log 10-3\log 2}$$
$$=\frac{1+{\cdot}47712-({\cdot}30103\times 2)}{1-({\cdot}30103\times 3)}$$
$$=\frac{1{\cdot}47712-{\cdot}60206}{1-{\cdot}90309}$$
$$=\frac{{\cdot}87506}{{\cdot}09691}$$
$$=9{\cdot}029\ldots$$

$\therefore$ Time = A little more than 9 years. Ans.

9. M. R. S.—An annuity of £3,675 per annum for 5 years is agreed to be discharged by a single payment at the end of the 3rd year; interest at 5 per cent. per annum is to be paid on the first two instalments overdue, and discount at the same rate is to be deducted from the instalments to be paid in advance; the amount of the first instalment and the present value of the last are to be reckoned by compound interest; what will the whole payment amount to?

Let P denote the payment in pounds, A the annuity and R the amount of one pound in one year.

$$\text{Then, } P=A\left(R^2+R+1+\frac{1}{R}+\frac{1}{R^2}\right)$$
$$=3675\{(\tfrac{2\,1}{2\,0})^2+\tfrac{2\,1}{2\,0}+1+\tfrac{2\,0}{2\,1}+(\tfrac{2\,0}{2\,1})^2\}$$
$$=3675(\tfrac{4\,4\,1}{4\,0\,0}+\tfrac{2\,1}{2\,0}+\tfrac{4\,0}{4\,0}+\tfrac{4\,0}{4\,4\,1}+\tfrac{4\,0\,0}{4\,4\,1})$$
$$=3675\times\frac{194481+361620+168000+160000}{176400}$$
$$=\frac{2\mathcal{E}7\mathcal{E}\times 884101}{1\mathcal{E}7\,4\mathcal{E}\mathcal{E}}$$
$$48$$
$$=18{,}418\tfrac{2\,4}{2\,5}.$$

$\therefore$ Single payment = £18,418 15s. 5d. Ans.

10. NEVER DESPAIR.—If $ax+by=1$,
then $ab(x^2+y^2)+(a^2+b^2)xy+(a-b)(x-y)=1$.
(*Certificate*, 1884.)

$$\begin{aligned}
&ab(x^2+y^2)+(a^2+b^2)xy+(a-b)(x-y)\\
&=abx^2+aby^2+a^2xy+b^2xy+ax-bx-ay+by\\
&=a^2xy+abx^2+aby^2+b^2xy+ax+by-ay-bx\\
&=ax(ay+bx)+by(ay+bx)+(ax+by)-ay-bx\\
&=(ax+by)(ay+bx)+1-ay-bx\\
&=ay+bx+1-ay-bx\\
&=1. \quad \text{Ans.}
\end{aligned}$$

11. NEVER DESPAIR.—Investigate the rule for expressing a number N in the scale of which the radix is t.

Express the lengths 38 feet 5 inches and 50 feet 4 inches in the duodenary scale; multiply them in that scale, and reduce the area found to the denary scale. (*Certificate*, 1884.)

(1) Suppose $p_0, p_1, \ldots\ldots p_n$ to be the required digits by which N is expressed in the new scale, beginning with that on the right hand; then

$N=p_nt^n+p_{n-1}t^{n-1}+\ldots\ldots+p_2t^2+p_1t+p_0$: we have now to find the value of each digit.

Divide N by t, and let Q_1 denote the quotient; then it is obvious that

$$Q_1=p_nt^{n-1}+p_{n-1}t^{n-2}+\ldots\ldots+p_2t+p_1,$$

and that the *remainder* is p_0.

Hence p_0 is found by this rule:—Divide the given number by the proposed radix, and the remainder is the first of the required digits.

Again, divide Q_1 by t, and let Q_2 denote the quotient; then it is obvious that

$$Q_2=p_nt^{n-2}+p_{n-1}t^{n-3}+\ldots\ldots+p_2,$$

and that the *remainder* is p_1. Hence the second of the required digits is found.

By proceeding in this way we shall find in succession all the required digits.

$38=(3\times12)+2=32$ in the duodenary scale;
5 in. $=\frac{5}{12}$ ft. $=\cdot5$ " " ;
$50=(4\times12)+2=42$ " " ;
4 in. $=\frac{4}{12}$ ft. $=\cdot4$ " " ;

32·5
42·4
1098
64t
1098
1151·78

ten | 1151
ten | 141...3
ten | 17...3
1...9

∴ 1151 in the duodenary scale
$=1933$ in the denary scale.
·78 in the duodenary scale
$=(\frac{7}{12}+\frac{8}{144})$ in the denary scale
$=\frac{92}{144}$ in the denary scale.
∴ Area $=1.033$ sq. ft. 92 in. Ans.

12. W. H. B.—Solve:—
$x^2+36=9x$. (*Scholarship*, 1874.)

$$\begin{aligned}
x^2+36&=9x\\
x^2-9x&=-36\\
x^2-9x+(\tfrac{9}{2})^2&=\tfrac{81}{4}-36\\
&=\frac{81-144}{4}\\
&=-\tfrac{63}{4}\\
x-\tfrac{9}{2}&=\frac{\pm\sqrt{-63}}{2}\\
\therefore\ x&=\tfrac{9}{2}\pm\frac{\sqrt{-63}}{2}\\
&=\frac{9\pm3\sqrt{-7}}{2}\\
&=\tfrac{3}{2}(3\pm\sqrt{-7}).
\end{aligned}$$

13. E. J. BARRETT.—The number 113,140,331 is in the scale of 7. Conduct the operation of finding its cube root in that scale.

113,140,331(362
36

$3^2\times300=3,600$	44,140
$3\times6\times30=1,050$	
$6^2=51$	
5,031	42,246
$36^2\times300=624,300$	1,561,331
$36\times2\times30=3,210$	
$2^3=4$	
630,514	1,561,331

∴ Cube Root $=362$. Ans.

14. QUINTINE.—If $p_0, p_1, p_2, \ldots\ldots$ be the digits of a number beginning with the units, prove that the number itself is divisible by 8, if $p_0+2p_1+4p_2$ is divisible by 8. (*Todhunter.*)

The number consists of $100p_2+10p_1+p_0+$some multiple of a thousand.

Now a thousand is divisible by 8;
∴ The number is divisible by 8 if

$100p_2+10p_1+p_2$ is divisible by 8;
that is, if $8(12p_2+p_1)+4p_2+2p_1+p_0$ is divisible by 8;
that is, if $4p_2+2p_1+p_0$ is divisible by 8.

15. MUNCH.—Prove that a number in the octenary scale is divisible by 7, if the sum of its digits is so divisible. (*Civil Service Candidate*)

Let N denote the whole number, $p_0, p_1, p_2\ldots\ldots p_n$, the digits beginning with that in the units' place, and let r denote the radix of the scale; then

$$\begin{aligned}
N&=p_0+p_1r+p_2r^2+\ldots\ldots+p_nr^n\\
&=p_0+p_1+p_2+\ldots.+p_n\\
&\quad+p_1(r-1)+p_2(r^2-1)+\ldots\ldots+p_n(r^n-1),\\
\therefore\ \frac{N}{r-1}&=\frac{p_0+p_1+p_2+\ldots\ldots+p_n}{r-1}\\
&\quad+p_1+p_2(r+1)+\ldots\ldots+p_n\frac{r^n-1}{r-1},
\end{aligned}$$

(And $\frac{r^n-1}{r-1}$ is an integer, whatever positive integer N may be)

$$\therefore\ \frac{N}{r-1}=\text{some integer}+\frac{p_0+p_1+p_2+\ldots\ldots+p_n}{r-1}.$$

That is:—In any scale of notation, if the sum of the digits is divisible by the number less by unity than the scale, the whole number is divisible by that number.

Thus, in the octenary scale, if the sum of the digits is divisible by $(8-1)$, that is, 7, the number is divisible by 7.

Mensuration.

1. TRASIMENUS.—Give the rule for finding the side of an equilateral triangle when the area is given.

Area $=$ Side$^2\times\cdot433$,
Side$^2=$ Area $\div\cdot433$,
∴ Side $=\sqrt{\text{Area}\div\cdot433}$.

2. IGNORAMUS.—To paint the outside of a cistern 6ft. long, 5ft. wide, 4ft. deep (including the cover) at 6d. per square foot, costs 4s. 11d. more than to paint the inside. Find the thickness of the cistern. (*Certificate*, 1884.)

Let T stand for thickness of cistern in ft.;
Then,

$$\begin{aligned}
&[\{(6\times5)+(6\times4)+(5\times4)\}\times2]\\
&\quad-[\{(6-2T)(5-2T)+(6-2T)(4-2T)\\
&\qquad+(5-2T)(4-2T)\}\times2]=\tfrac{49}{6},\\
&\{(30+24+20)\times2\}-\{(30-22T+4T^2+24-20T\\
&\quad+4T^2+20-18T+4T^2)\times2\}=\tfrac{49}{6},\\
&(74\times2)-\{(74-60T+12T^2)\times2\}=\tfrac{49}{6},\\
&(60T-12T^2)\times2=\tfrac{49}{6},\\
&12T^2-60T=-\tfrac{49}{12},\\
&T^2-5T=-\tfrac{49}{144},\\
&T^2-5T+(\tfrac{5}{2})^2=\tfrac{25}{4}-\tfrac{49}{144}\\
&\quad=\frac{900-59}{144}\\
&\quad=\tfrac{841}{144},\\
&T-\tfrac{5}{2}=\pm\tfrac{29}{12},\\
&T=\tfrac{5}{2}\pm\tfrac{29}{12},\\
&\therefore\ T=\tfrac{1}{12}\text{, or }\tfrac{49}{12}.
\end{aligned}$$

∴ Thickness of cistern $=\frac{1}{12}$ft.
$=1$in. Ans

3. Laringtonian.—If the cubical content of the earth is taken as 236,855,164,967 cubic miles, what is its circumference, and the area of its surface? (*Lewis.*)

Volume of sphere = Diameter^3 × ·5236;
Surface " = Diameter × Circumference.

cub. miles. cub. miles.
·5236)236,855,164,967(452,358,985,804
20944
27415
26180
12351
10472
18796
15708
30884
26180
47049
41888
51616
47124
44927
41888
30390
26180
42100
41888
21200
20944
256

cub. miles. miles.
452,358,985,804(7,676
343
$7^2 \times 300 = 14{,}700$ | 109358
$7 \times 6 \times 30 = 1{,}260$ |
$6^2 = 36$ |
15,996 | 95976
$76^2 \times 300 = 1{,}732{,}800$ | 13,382,985
$76 \times 7 \times 30 = 15{,}960$ |
$7^2 = 49$ |
1,748,809 | 12,241,663
$767^2 \times 300 = 176{,}486{,}700$ | 1,141,322,804
$767 \times 6 \times 30 = 138{,}060$ |
$6^2 = 36$ |
176,624,796 | 1,059,748,776
81,574.028

∴ Diameter = 7,676 miles.
Circumference = (3·1416 × 7,676) miles.
7676
18 8496
219 912
1 884 96
21 991 2
24,114·9216 miles. Ans.

Surface = (24,114·9216 × 7,676) sq. miles
7676
144 689 5296
1 688 044 512
14 468 952 96
168 804 451 2
185,106,138·2016 sq. miles. Ans.

General.

1. Merci.—The solution of your query appeared in our issue for June, 1882.

2. Thine.—You will find the solution of your query in our issue for March, 1883. No. = 715, 1435, 2155, etc., as every common multiple of 16, 18, and 20, decreased by 5, fulfils the conditions.

3. ——.—The solution of the arithmetic query from *Hamblin Smith* (Answer, 375 and 390 grains) appeared in our issue of February, 1882.

4. K. A.—Your query was solved in our issue for April, 1883.

5. A Young Teacher.—If you will kindly comply with Rule 2 of the Query Column it will be a pleasure to reply to your query.

6. Moniebro.—"My Scholarship Answers, 1884," by Mr. H. D'Albertanson, first on the Scholarship List, appeared in the January and February issues of this journal. We shall be glad to send them post free upon receipt of 1s. 3d.

7. University.—(1). Yes. (2). Write to the Registrar of the London University for prospectus.

8. Cyclops.—The solution of your query appeared in our issue for March, 1883.

9. Julius.—You will find the solution of your query in our issue for May, 1882.

10. Fido.—Your query was solved in our issue for August, 1882.

11. Owen Tudor.—(1) Multiply average by No. of years, and the result will be the quantity raised in the period. Then subtract quantity raised in 1855, add quantity raised in 1863, and divide by No. of years. The result will be the average from 1856–1863.

(2) Hands will be exactly opposite at $(15 + \frac{1}{11}$ of 15 min.) past $9 = 16\frac{4}{11}$ min. past 9.

hrs. sec. hrs. min. sec.
Then state, 59 50 : 12 $1\frac{4}{11}$ :: 10 : Time lost
$= 2_{59}\frac{32}{649}$ min.
∴ Correct time $= (16\frac{4}{11} + 2_{59}\frac{32}{649})$ min. past 9
$= 18$ min. $22\frac{32}{649}$ sec. past 9.

12. Puzzled.—The ratio of the diameter to the circumference of a circle is 113 : 355.

$\frac{355}{113} = 3{\cdot}14159\ldots$

13. Subscriber.—You will notice that your query has been solved for another correspondent.

14. Michael Waters.—You have evidently copied your query incorrectly, as the resultant is considerably greater than the answer you give. Through the given point draw two lines at right-angles to each other in the plane of the forces, and resolve each of the forces into two others. Then the resultant of the three forces is the square root of the sum of the squares of the resultants at right-angles to each other.

15. Bonne.—The solution of your query appeared in our issue for February, 1882.

16. J. W. Robinson.—(1) Nouns having different meanings in the singular and plural—

spectacle	spectacles
copper	coppers
vesper	vespers.

(2) Nouns having two meanings in singular and one in plural—

counsel	counsels
watch	watches
air	airs.

(3) Words having two meanings in plural and one in singular—

cloth	cloths, clothes
penny	pence, pennies
letter	letters, letters = (literature).

17. Zinco.—We do not think you can do anything till the list comes out, because if you are high enough on the list you will be admitted. If you are too low, write at once to the secretary of the college you would like to enter. You may be admitted. At the same time you could not claim it, nor complain if there should be no room. It was a mistake in the first instance to select a place where you were almost sure to be rejected.

18. Brownie.—The large hand is promising, but needs much improvement; the small hand is fair, except the capital letter; 65 and 60 respectively.

19. Corrigenda.—Your list of books is very good, and will answer your purpose. It is not a full list; you might add *Hall's* 'Algebra,' Macmillan and Co., and *S. Brooke's* 'Primer of English Literature,' 1s. 'Catch Questions in Arithmetic,' by *Cafel.* For music, use *Curwen's* 'Construction Exercises,' Part B.

20. ——For the examination in acoustics, light, and heat, read *Everett's* 'Physics,' 2s. 6d. (Blackie), together with the book you name which is out of date. *Findlater's* book and *Prince's* 'Physiography' will be sufficient for your purpose. You do not forget that Huxley has written a book on the subject. The manual on school management is old. The manuals of the National Society are good *Fitch's* 'Lectures' are excellent.

21. Obliged.—Yes, you will obtain marks for success in Hygiene. The number of marks is not published.

22. Le Petit Guillaume.—For the music paper at the Certificate Examination you can use *Curwen's* 'Construction Exercises,' Part B. If you refer to the first year, you should consult the Music Lessons in the Practical Teacher for 1882-3, by *R. Dunstan*, Mus. Bac., which contain all that is required in the way of theory.

23. Burrell.—We believe the price is 8s. 6d. Copies can be got at old book stalls from 2s. 6d. to 5s. *Abbott's* 'Shaksperean Grammar' is 6s. 'The Science and Art of Teaching,' by the National Society, is 5s. 6d.

24. Munch.—Large hand, 50; small hand, 70. The large hand letters are small, especially the letters *p*, *h*, and *f*.

25. W. H. B.—A, 70 large, 75 small; B, 65 and 72; C, 62 and 70; D, 60 and 70. In A the large hand is pretty good; the down strokes are not perfect; the curves are too angular. Small hand is fair, but does not contain a single excellent letter. Practise some good copies.

26. J. Alison.—For 'De Senectute,' use *White's* edition if you want one with a vocabulary, and *Sidgwick's* if you want one with excellent notes. *A. S. Wilkins'* edition of 'Pro Lege Manilia' will suit you. You had better wait and see whether an annotated edition of 'The Iliad,' Book 16 is announced. We know of none at present.

27. Jennie.—The rules of punctuation are printed at the end of *Morell's* 'Grammar,' and are found in many books. But a little knowledge of grammatical terms is essential, otherwise the rules cannot be understood. You cannot learn punctuation apart from grammar.

28. Anxious.—You can enter another school as Ex.-P.T. only on condition of having passed the scholarship examination, or of having passed the 5th Year's Examination for Pupil Teachers. See Code.

It would also be well to complete your course according to agreement.

29. W. Aldridge.—There is no science examination in the certificate week. The science subjects are examined in the previous week. None but those who have attended classes in the previous year are examined. The language-paper can be taken, and also the history and geography. It is doubtful if marks can be got for a science certificate obtained in the May Examination for the purpose you name.

30. W. H. B.—There is a cheap manual by Ainstey, of Cardiff, and a more expensive one called *Norrie's* 'Epitome.' Look at them if you dont like the one you name.

31. A Constant Reader.—If you compare Ross with Curtis and Hume, you will find some giving one date and some another. All these dates would be accepted in an examination. The meaning of the discrepance is that these dates are to a large extent clever guesses. When you have an opportunity read the first fifty pages of *Green's* 'Short History of the English People.' After doing so, you will wonder why boys are made to learn untrustworthy dates for events which perhaps never occurred.

32. Caithnessian.—(1) We think not. (2) We should think you must have been qualified to teach the subject when you began in order to earn grants. (3) We can never say which is the best. We should recommend *Curwen's* 'Courses for the Tonic Sol-Fa.'

33. Ignis Montis.—We should recommend *Greenwood's* 'Sailor's Sea Book' (Weale, 2s. 6d.). 'Navigation and Nautical Astronomy,' by *Young* (Weale, 2s. 6d.). See also the reply to (30) W. H. B.

34. Inquirer.—See the reply to (26) J. Alison. Dont be in a hurry with your *Homer*. Read *Rushbrooke's* 'First Greek Reader.' *Homer* is about the worst possible author for a beginner. *Homer* ought never to be set for the matriculation.

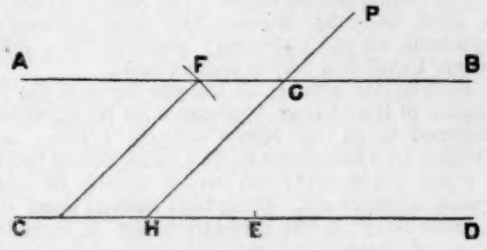
35. ————.—The sum you quote is wrong; the 3 months was a slip. It should be four months, and four per cent.

36. Colonna.—'With soul so dead' was by error put in the extension. It should be taken as an enlargement of the subject.

37. Alphonso.—The solution of your query appeared in our issue for June, 1884.

Geometry.

1. E. J. Griffith.—Through a given point draw a line so that the part of it intercepted between two given parallel lines may be equal to a given line. Show that there may be one, two, or no solutions. (*P. T. Course of Mathematics.*)



Let AB, CD be the given parallel straight lines, CE the given length, and P the given point.

Construction.—With centre C and distance CE describe an arc cutting AB in F.

Join CF, and through P draw PGH parallel to FC. (I. 31.)

Then GH shall be equal to CE.

Proof.—FCHG is a parallelogram,

$$\therefore GH = CF (I.\ 34) = CE.$$

Note.—If the arc touches AB there will be one solution; if it cuts it, it will cut it in two points, and therefore there will be two solutions; and if it does not touch or cut it, there will be no solution.

Q. E. F.

Slojd.

A Short Description of a System of Handiwork taught in many Elementary Schools in Sweden, by J. W. Warren, Inspectress, School Board, Leicester.

I believe it is now an accepted fact that all intelligent educators are of the same opinion on the following point, viz., that no scheme of elementary education is perfect that does not provide some means whereby that much-despised but beautiful organ, the hand, is educated, and that it behoves us to look well to the matter if we would keep pace with our Continental neighbours. Several meetings have already been convened in the different educational centres of England, to make this subject one of special study and thought, and it therefore seems to me not an unfitting time to do what little lies in my power, to make the excellent system I have had the pleasure of learning in Sweden more fully known, especially as it is so possible a scheme to introduce into English schools. I am encouraged to write these papers also from the fact that since my return from Sweden I have received letters from all parts of the United Kingdom and America, begging me to forward more information than could be gleaned from the reports of my few lectures given in London during last autumn.

With these few words of apology and introduction I will therefore close, trusting that, if in the course of my descriptions I am ambiguous, my readers will accord me their sympathy, remembering the while that I laboured under the disadvantages of a foreign tongue and a totally new form of education, namely, the education of the hand, and that in writing now I have to meet yet another difficulty, that is, to make clear to others what I have so recently learned myself.

The word Slöjd is Swedish, and admits of no very clear translation into English, but on referring to the simpler Swedish lexicons, I observe it to mean working with the hand; but as used by the promoters of the system in question it has a wider view altogether. *Hand-training* or *Hand-education* would, perhaps, be a more fitting interpretation. The Nääs Slöjd differs in some important respects from other schemes of handicraft on the Continent; and with these differences I shall deal fully in another paper.

Early in the summer of last year (through the invitation of Herr August Abrahamson) of Nääs, Sweden, tendered to us by Miss Concordia Löfving, late Swedish Drill Inspectress to the London School Board, a friend and myself visited Sweden to study the Slöjd system of handiwork. Being head teachers under the London Board, it was necessary to get an extended leave of absence, and this was obtained for us by Mrs. Westlake, who is ever indefatigable where any real good in education can be effected.

"Nääs" is the name of an estate belonging to Herr August Abrahamson, a retired Jewish merchant; it is about two hours' ride from Gottenberg and a day's journey from Stockholm. To say that Nääs is beautiful is to leave much unsaid, which I must reluctantly do, for I remind me that Slöjd is my subject, not "*Nääs.*"

We found on arriving that amongst numerous chateaux on the estate, one Vanam (the house of friends) was specially prepared for foreign visitors.

Herr Abrahamson provides in no meagre way for his guests, who receive instruction in Slöjd free; and save that the Swedes pay a nominal sum for their board, everything from beginning to end is a free gift.

We found several foreigners here besides ourselves, who, like us, when at home were engaged in teaching, and at the particular course we were attending Russia, Denmark, Germany, Norway, and Finland were represented. Some of these countries were already in possession of a Slöjd system, but the fame of "Nääs" had spread far and wide, causing them to beg of the founder an invitation for their inspectors and teachers. An interesting custom prevails on the estate, of hoisting the flags of the different nations represented in the Slöjd school, and it was both curious and flattering to see the great amount of interest caused by the running up of the Union Jack for the first time; we were a day earlier than most of the other visitors, so enjoyed to the full the surprise depicted at the sight, and the still further inquiry as to which were from England; but the discovery that England had sent women to Slöjd capped the climax of our vanity, for referring to it often when we knew each other better, they told us they did not think 'English ladies could work with their hands.' Need I add that we undeceived them, saying that English women could do all they willed to do, and that English teachers could do and dare anything for the good of their schools? But I fear I digress.

After a day's rest we were initiated into the mysteries of the daily routine, and we were expected to conform strictly to it during the six weeks necessary to complete a first course. I think I cannot do better than describe the routine of one day, in order that my readers may in a measure realise how it was possible in so short a time for us to have more than the merest cursory knowledge of so useful a subject.

From six to eight in the morning the workroom was open to all who wished to avail themselves of it before breakfast, the Slöjd master in attendance, Herr Otto Saloman, nephew to Herr A. Abrahamson, and director, gave a lecture in Swedish on the work to the Swedish teachers and Fins.

Breakfast was served at eight o'clock.

At nine the Slöjd room bell rang, and then all were expected to be at their benches, where work was carried on most industriously with but twenty minutes' compulsory rest until one p.m. At two p.m. we went again to the workrooms, and continued until five, when labour was finished for the day. Some hour during the morning Director Saloman lectured in German to those who did not attend the Swedish exposition. We, not understanding either language, took our lecture in the evening, Mr. Saloman sparing no pains with what little English he knew to make us understand the Slöjd. He is, without exception, the cleverest demonstrator I have ever heard. We often came from these evening lessons saying that we had learnt more in the hour than any one else had ever taught us in a month. This is the kind of thing that went on for six weeks, Herr Abrahamson coming up from "Nääs Proper" every day, and by every means, in his power infusing the spirit of work into us, planning little excursions in our leisure, and giving us musical evenings and dinner-parties in his grand old home. Boats we could have without the asking; the beautiful lake running at the bottom of the grounds resounding with song and merriment. It is but a very small tribute to all the dear friends at Nääs to say that here indeed were we shown the active, living sentiment of the words, 'Freely ye have received, freely give.'

The time passed all too quickly. Exhibition speech and parting day came, and we strangers (bound by a common work as friends) parted, some never to meet again, but each the richer for the seven weeks' Slöjding together; of that we were convinced.

My friend and I spent a week in Stockholm, visiting nearly every Slöjd school there, and also at Gottenberg on our way home.

In the former beautiful city we were greatly assisted by Dr. Meyerbere, Chief Inspector of Schools, and Mrs. Newson. Every facility was offered us for visiting schools, and not a few meetings organised in our behalf. I can only say that Swedish hospitality and disinterested kindness beggars description. Finally we landed in England possessed of a diploma for Slöjd, and forty articles our own work as the result of our labours in the Slöjd rooms.

In the following papers I shall deal with the details of the work and the manner in which it is introduced into the Swedish schools.

(To be continued.)

The Coming Examination for Pupil Teachers.

Nearly half the Pupil Teachers throughout the country are looking forward to the yearly examination to be held on the last Saturday of the present month. The feelings which are experienced in anticipation of that event are very different in different individuals. Many pupil teachers have been conscientiously and earnestly plodding through their appointed tasks, others have pursued their studies by fits and starts,

while some have been trying to crowd into a few months or weeks the work of the whole year. Some feel masters of the situation, while others dread the ordeal most sincerely, and a few hate it with a perfect hatred. Some have no fear of the result, while others are extremely nervous and anxious about the report on their work. All will, no doubt, try to do well, for their own sake or that of their school and teachers.

To enable teachers to do this, to bring credit to themselves and to their schools, is the object of this Paper. It contains some practical hints as to the best means to ensure success.

In the first place we would say to the pupil teacher, *Do not drive preparation for the examination to the last moment.* There will be five weeks between the date of publication of this magazine and the examination day—use them well. Revise carefully the whole year's work. Apportion the time for study carefully, so that the subjects in which you are least proficient shall have most attention. Especially be careful to know the rules and reasons for the rules in arithmetic, the dates in history, and the facts of geography. Leave nothing to be done at the last moment. On Friday night everything should be cleared off, and a good night's rest should be secured, so that the mind may be fresh and vigorous for the coming day.

In the next place, we would say: *Economise your time.* The best of students find the time allotted to the papers all too short for the answers they are expected to give. That you may have all of it for the actual work of the examination, *do as much as you can beforehand.* You are quite aware of the subjects in which you will be examined. Remember that inspectors, like other people, are glad to have their work made as light and as easy as possible. They wish to know exactly what they have to do, and where to look for it, and whose work they have to examine. Now on the first page of the paper of questions there is a list of directions, and among these you are told to write your name, your year, and your school at the head of each sheet of paper you use. There is nothing to prevent this being done beforehand. To have it to do at the examination would take up ten to twenty minutes of valuable time. At the head of each sheet, therefore, write the following particulars:—(*a*) your name; (*b*) the name of your school; (*c*) the place where it is situated; and, (*d*) your year, thus:—

First Year. John Smith,
St. Andrew's National School,
Monkton.

Rule this off neatly with black or coloured ink. Be sure to select good paper with a marginal line. As you know the subjects in which you are to be examined, write on as many sheets or half sheets as you think you will require the names of the subjects, in a fair round hand. Having provided yourself with pens, paper, knife, pencil, and ruler, take care to be at the appointed place ten or fifteen minutes before the appointed time. When seated, and the papers are distributed, if not seated so as to see the school clock, take out your watch, if you have one, and place it on the desk near you. You will then be able to see how the time passes, and to judge whether you ought to write faster or not. *First, read the rules and fill up the first page of the paper of questions.* This is important and must on no account be omitted. When done, turn to the inside of the paper and read every question carefully. As you have separate sheets of paper for each subject, it does not matter which you begin with; *select that which you can do best and begin with it.* Do not imagine, however, that long answers in one subject will make up for no answers or imperfect answers in another. Each subject stands by itself, and you will get marks according to the kind of answers in each. Try, therefore, to let your answers be clear, concise, and to the point. Many of the answers given to the papers from time to time printed in the Practical Teacher might have been longer and fuller, but they have been made of such a length as would be expected from a pupil teacher in an examination room, and you could not do better than take them as your model.

Supposing, then, you have read carefully the whole of the questions in every subject, and you have selected the questions which you can do, or are expected to do, next divide your time into so many minutes for each question. Of course some answers will take much shorter than the average time. These will allow you the opportunity of bestowing more time on the more difficult questions.

Do not waste time by writing the questions.

Having selected your question put the number in the margin of the paper you are to write upon, and set to work. Write legibly in a bold round hand, avoiding all flourishes. Do not write close; you have plenty of paper and room for every answer, and it is only irritating to the examiner, and is certainly a sure way to lose marks to write in a cramped hand with a fine-pointed pen, or with scrawls and flourishes, which serve only the purpose of confusing all who attempt to read what is written. Leave a line or two of space between the answers, each of which should be ruled off neatly.

In working arithmetic papers be sure that your figures are neat, and large enough to be easily read. Let the processes be perfectly clear and intelligible, and do not be afraid to write against results what they are, either for your own guidance in the remaining part of the solution or as evidence that you understand your work. Take care that you read the questions correctly, and do not have the mortification of finding when the work is done you have misunderstood what was expected of you. In nearly every Examination Paper questions are set to test your knowledge of rules and processes, and reasons for processes. These are often asked in such a way that a common-sense answer may be given without its being necessary to quote the exact words of any text-book. Give such common-sense answers if you can, but if it is absolutely necessary to give an answer in the words of a text-book take care to quote correctly. An incorrect answer to a question of such a kind will tend to show up your want of knowledge more than the omission of many facts which can be acquired by an act of memory. When the time allowed is nearly expired, read over carefully what you have written, inserting any words or stops which may have been accidentally omitted, and erasing anything which mars the accuracy or neatness of the papers. When finished, do as requested, place your written answers, properly numbered and in the order of the printed questions

in the sheet given to you, and hand them in to the Inspector in that form.

Attention to these minute details cannot fail to assist in making the examination pass off more pleasantly and satisfactorily to yourself and others than it otherwise would. Each subject is judged on its own merits, and the general result attained will be that of failure or passing fairly or well. Failure in any subject is marked thus: o, and attention is drawn to the necessity for better preparation by an asterisk, thus *. Pupil teachers should always remember that their failure reflects discredit on themselves, on their teachers, and on their school. It entails also a loss of grant. A payment of forty shillings is made for a fair pass, and of sixty shillings if the teacher passes well. In many cases this amount is divided between the pupil teacher and his teacher, and it must be an incentive to some to know that their efforts will be, even though faintly, yet in some measure rewarded. We wish every pupil teacher who reads these lines a pleasant and successful examination.

During the coming year it is in contemplation to alter the character of the pupil teachers' work given hitherto in the PRACTICAL TEACHER. The alteration of the time of holding the Annual Examination to the months of October and April only will allow us to attend to the wants of head and pupil teachers during the year, as well as for examination only. The October and April teachers will, therefore, each be provided with (1) a Quarterly Examination; (2) a Half-yearly Examination; (3) the two sets of Government Examination Papers, and two sets of our own Questions, with Model Answers; (4) a set of Prize Questions; (5) a set of Test Questions in the month preceding their examination, and (6) two or more Practical Papers connected with their every-day work, their studies, or their future examinations and prospects.

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Science Notes.

THE British Association for the Promotion of Science has just held its twenty-sixth meeting at Aberdeen. The address of the president, Sir Lyon Playfair, is one which everybody can read and understand. It is a powerful appeal for a much fuller recognition of the claims of science schools in the universities and by the State. Teachers in primary schools and science classes will see that the president notices their work. He says: 'The working classes are now receiving better instruction in science than the middle classes. There are also 78,000 persons who annually come under the influence of the science classes connected with the Science and Art Department; about 200 of them, many of them teachers, receive thorough instruction in science in the excellent school at South Kensington, of which Professor Huxley is the dean.' The president points out that science lags in its progress in the United Kingdom, owing to the deficient interest taken in it by the middle and upper classes. It would be unfair to conclude that the president, or any one else who understands the subject, is satisfied with the scientific instruction which the working classes now receive. The fact is worth recording, however, that in the opinion of Sir Lyon Playfair it is superior to that given in the secondary schools. In Scotland there are only six endowed schools which give more than two hours per week to science, while in many schools its teaching is wholly omitted. This will hardly be pleasant news to those who are never tired of pointing out the wretched condition of everything connected with English primary education.

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WE have read through all the presidential addresses to the sections. They are pronounced by competent judges to be excellent. Two of them are of special interest to teachers. Professor G. Chrystal draws attention to scientific text-books. He laments that publishers palm off upon the public the ill-paid work of fifth-rate workmen. Earnest students lament it, too. They cannot understand why the professors do not let us know the present state of knowledge of their subjects, unless it be that they would no longer be able to set questions at examinations which none of the students could answer. Professor Chrystal complains of the want of progressiveness in the teaching of algebra and geometry. We go on as though the great men of the last fifty years had never lived. We do not select the really important parts of the subject and deal with them in their mutual relation and applications to higher subjects, but waste time in interminable example grinding. He is specially severe upon the system pursued at Cambridge. 'We were directed,' he says, 'to work through old problem papers, and study the style and peculiarities of the day and of the examiner.' All practical teachers will agree with the professor that the absurd prominence of written competitive examinations works mischief. There is at present too much examination by half. But we cannot go so far as he does when he declares that the end of all education now-a-days is to fit the pupil to be examined. There are hundreds of teachers who love to teach a subject thoroughly. No doubt pupils who have been well taught do, as a rule, pass a creditable examination, but we need not grumble about that, provided they really understand the subject. We earnestly hope Professor Chrystal's suggestion will be adopted, that some of the greatest men of the day may be induced to write text-books which will put the best of all that is known within a student's reach. And as to the sort of questions that should be proposed to candidates, well, surely that is a matter for the professors themselves, since in many cases they are the examiners. Let them agree what should be done in the interests of science, and then do it. There may be some difficulty in agreeing; that is a matter for them; there would be very little in carrying their decisions into practice.

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PROFESSOR ARMSTRONG'S address should be carefully studied by science teachers throughout the country. His contention is that 'no one can fill with intelligence and success, a post either as teacher or industrial chemist, who has not been trained in the methods of research; that it is essential to make research an integral portion of the students' course in every college which pretends to educate chemists. It is not enough to set a promising student to investigate, but a number of students, as well as the staff, must always be engaged in original work; in fact, an atmosphere of research must pervade the college.' There is something refreshing in listening to a man who speaks

from his own knowledge. One would indeed wonder if such a professor failed to call forth in his students unbounded curiosity and enthusiasm. We know many teachers who would be delighted to spend perhaps a day a week in original work of some simple kind, if only they could obtain advice, help, and superintendence. At present many, indeed, most of the assistants in chemical laboratories are busily engaged in helping men to prepare for some definite examination, and they have little time or inclination to attend to anything else.

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We cannot, however, agree with much of Professor Armstrong's condemnation of nearly all the science instruction in the kingdom. We think the professor has greatly overstated his case, and thereby weakened it. He says, 'I do not wish to see science teaching introduced into schools generally, in order that the students who come to me may already have gained some knowledge of science; under existing circumstances I prefer that they shall not.' This is hardly in good taste. It means that those who teach chemistry at the present time lay the foundation so badly that the professor could not build upon it. Now nearly all those who are teaching chemistry under the Science and Art Department, and in the secondary schools of the country, have received some instruction for that work. Some have attended classes at South Kensington, some at King's College, some at University College, some at one place, and some at another. There are few teachers who have not found it to their advantage to obtain such systematic instruction. The professors in these establishments are among the most eminent chemists in the country. How comes it, then, that their pupils are quite incompetent to teach the elements of the subject? It would be a waste of time to show that the professor has generalised too fast. He has been unfortunate in some of his students. They did not 'know proportion, and looked aghast at a logarithm table,' and 'German was an unknown tongue to them,' and so on. Surely many of the professors could have told a more gratifying story. The study of chemistry may be in a bad way, but it is hardly so bad as Professor Armstrong paints it.

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We are afraid that there is a very wide divergence of opinion among the leading chemists as to what should be taught, and how it should be taught. Many of them are beginning to find out that a good deal of what they have very dogmatically laid down for years is open to grave suspicion. One of the most pressing needs of the time is that those at the head of the profession should come to some sort of agreement as to what subjects would be most useful and instructive. It is not edifying to see doctors differ. Judging from the current French and German text-books on chemistry, there can hardly be such a marked difference in the methods hitherto adopted as to leave the English immeasurably behind. The whole of the presidential addresses can be had in the form of a pamphlet. Many of our readers would enjoy studying them.

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Recent Inspection Questions.

[*The Editor respectfully solicits contributions—all of which will be regarded as* STRICTLY PRIVATE—*to this column. For obvious reasons, it cannot be stated in which district the questions have been set.*]

Arithmetic.

STANDARD I. (BOYS AND GIRLS.)

(1)	(2)	(3)	(4)
24	200	121	Write *four*
903	11	91	*times*
17			table.
555	189	30	
1499			

Sentence dictated.—One day two boys, Harry and Tom, had the same sum to do at school.

Words dictated.—Hand, finger, card, yellow, knife.

ANOTHER EXAMINATION.

(1)	(2)	(3)
685	902	410
549	70	109
376	460	
495	321	301
267	7	
2372	1760	

Words dictated.—Letter, night, miles, tears, penny, corner, clock, finger, cakes, coal.

STANDARD II.

(1)	(2)
93,906	9)51,102
87,228	5,678
6,678	

(3) $7,956 \times 950 = 7,558,200$.

(4) $27,568 \times 75 = 2,067,600$.

STANDARD III. (BOYS.)

(1) (In words.) Add £569 16s. 10½d.; £569,000 13s. 11¾d.; £7,080 15s. 11d.; £75 os. 0¾d.; £5,608 11s. 1½d.; £74,074 17s. 4d.

Ans. £656,409 15s. 3½d.

(2) From £300,150 10s. 0¾d. take £5,005 13s. 6¾d. Ans. £295,144 16s. 6d.

(3) Divide thirty-nine millions nine hundred and fifty-one thousand three hundred by five hundred and seventy. Ans. 70,090.

(4) The sum of two numbers is 69, and one is 13. Find the product of the two numbers.

$(69 - 13) \times 13 = 56 \times 13 = 728$. Ans.

(GIRLS.)

(1) From £30,000 os. 4d take £987 13s. 6¾d.

Ans. £29,012 6s. 9¼d.

(2) (In words.) Add £70,009 13s. 8½d.; £5,968 17s. 10¾d.; £6; £19 19s. 0½d.; 8s. 4d.; £80 os. 9½d. Ans. £76,084 19s. 9¼d.

(3) Find the difference between the twelfth part of 87,480 and the thirty-sixth part of 64,080.

87,480 ÷ 12 = 7,290
64,080 ÷ 36 = 1,780

Difference = 5,510 Ans.

(4) Divide ninety-one thousand and fifty by seventy-eight. Ans. $1,167\frac{4}{78}$.

STANDARD IV. (BOYS.)

(1) Divide one million two hundred and seventeen thousand four hundred and thirty-two pounds ten shillings by two hundred and forty.

Ans. £5,072 12s. 8½d.

(2) Reduce £999 19s. 9d. to threepences.

Ans. 79,999 threepences.

(3) Reduce 151,800 half-feet to miles.

Ans. 14 miles 3 fur.

(4) Seventy yards of cloth were bought at 8s. 6½d. per yard, and sold at the rate of 19s. 10d. for two yards. What was the gain?

19s. 10d. ÷ 2 = 9s. 11d. 9s. 11d. − 8s. 6½d. = 1s. 4½d.
1s. 4½d. × 75 = £5 3s. 1½d.

(GIRLS.)

(1) Multiply £96 14s. 8½d. by 86.

Ans. £8,319 4s. 11d.

(2) Divide £8,910 4s. 5d. by 94.

Ans. £94 15s. 9½d.

(3) Reduce thirty-five thousand pints to quarters.

Ans. 68 qrs. 2 bush. 3 pks. 1 gal.

(4) How many packets, each containing 4 lb. 8 oz., can be made out of 6 stone 10 lbs. 8 oz.?

189 half pounds ÷ 9. Ans. 21 packets.

STANDARD V. (BOYS.)

(1) A bill (make out and receipt):—

	£	s.	d.
23 bush. of coke at 4½d. per bush. ...	0	8	7½
19 galls. of tar at 1¾d. per gal.	0	2	9¼
17 gas burners at 2s. 7½d. each	2	4	7½
3,520 cubic ft. of gas at 3s. 8d. per 1,000 ft.	0	12	10¾
Hire of meter, 7 months, at 7s. 6d. per year	0	4	4½
	£3	13	3½

(2) Find the value of 23 ac. 3 r. 29 p. at £7 10s. 8d. per acre.

Ans. £180 5s. 7½d.

(3) $\frac{3}{5} + \frac{4}{9} + \frac{2}{3} - \frac{1}{5} - \frac{2}{9}$. Ans. $1\frac{7}{15}$.

(4) A farmer bought a cow for £12 10s. and a horse for £26. He sold the cow at a loss of £1 15s., and the horse at a profit of £3 3s.; and out of the money bought 26 sheep, and then had £3 10s. What was the price of a sheep?

(£12 10s. + £26 + £3 3s. − £1 15s. − £3 10s.) ÷ 26
= £1 8s. Ans.

(GIRLS.)

(1) From £20 16s. 5⅜d. take £19 17s. 4¼d.

Ans. 19s. $1\frac{5}{12}$d.

(2) Find the cost of 397 articles at £6 5s. 10d. each. Ans. £2,696 5s. 10d.

(3) If 91 books cost 117 guineas, what should one dozen and nine cost?

117 guineas = £122 17s.
91 : 21 :: £122 17s. : £28 7s. Ans.

(4) Make out and receipt the following bill:—

	s.	d.
13¼ yds. calico at 8d. per yard ...	8	10
8 prs. socks at 1s. 6½d. per pr. ...	12	4
4¾ yds. ribbon at 1s. per yd. ...	4	9
2½ doz. collars at 6½d. each ...	16	3
	£2	2	2

STANDARD VI. (BOYS.)

(1) Reduce ⅜ of 1½ of 10s. 7½d. to the vulgar and also the decimal fraction of £4 4s. 4½d.

$\frac{\frac{3}{8} \times \frac{3}{2} \times \frac{255}{2}}{\frac{20}{2} \times \frac{255}{2}} = \frac{3}{8} \times \frac{3}{2} \times \frac{255}{2} \times \frac{2}{20 \times 255} = \frac{17}{2 \times 40}$. Ans.

$\frac{17}{240} = .0708\dot{3}$. Ans.

(2) Find the simple interest on £385 for 6⅕ yrs. at 2¾ per cent.

$\frac{385 \times 6\frac{1}{5} \times 2\frac{3}{4}}{100} =$ £65 12s. 10½d. Ans.

(3) If 6·125 lbs. cost £1 7s. 6d. how much will 1¾ cwts. cost?

lbs. lbs.
6·125 : $1\frac{3}{4} \times 112$ :: £1 7s. 6d. : £44. Ans.

(4) A waistcoat contains ·95 yd. cloth. How many can be made from 346¾ yds.?

346·75 ÷ ·95 = 365. Ans.

(GIRLS.)

(1) If I receive £9 11s. 4d. for the loan of £287 for a year; what is the rate per cent.?

£ £ £ s. d.
287 : 100 :: 9 11 4 : £3 6s. 8d. Ans.

(2) A. Add $\frac{2}{3}$ to $\frac{3}{4}$. B. Take $\frac{2}{3}$ from $\frac{3}{4}$. C. Multiply $\frac{2}{3}$ by $\frac{3}{4}$. D. Divide $\frac{2}{3}$ by $\frac{3}{4}$. Add the four answers together and say how much less the sum is than three.

$3 - \{(\frac{2}{3} + \frac{3}{4}) + (\frac{3}{4} - \frac{2}{3}) + (\frac{2}{3} \times \frac{3}{4}) + (\frac{2}{3} \div \frac{3}{4})\}$
$3 - (1\frac{5}{12} + \frac{1}{12} + \frac{1}{2} + \frac{8}{9})$
$3 - 2\frac{2}{9} = \frac{7}{9}$. Ans.

(3) Divide 300·03 by ·054 and express the answer as a vulgar fraction.

300·03 ÷ ·054 = 5556·i
= $5556\frac{1}{9}$. Ans.

(4) If $\frac{4}{7}$ of a concern be worth £376, what will $\frac{5}{9}$ be worth?

$\frac{4}{7} : \frac{5}{9}$ :: £376 : £274 3s. 4d. Ans.

STANDARD VII. (BOYS.)

(1) If 15 men mow a field in 5 days, working 12 hours a day, how long will 20 men be, working 9 hours a day?

days days
men 20 : 15 :: 5 : 5. Ans.
hrs. 9 : 12

(2) A dealer buys 75 yards of carpet at 4s. 6d. per yd., and sells it for £30. Find his gain per cent.

£30 − 4s. 6d. × 75 = £13 12s. 6d. gain
£16 17s. 6d. : £100 :: £13 12s. 6d. : £77$\frac{7}{9}$.

(3) In a school of 200 children, 50 pay 2s. 6d., 30 pay 3s. 6d., 40 pay 5s., and the rest 2s. each. Find the average payment by each scholar.

	£	s.	d.
50 at 2s. 6d. =	6	5	0
30 at 3s. 6d. =	5	5	0
40 at 5s. =	10	0	0
80 at 2s. =	8	0	0
200)	29	10	0

2 11$\frac{2}{8}$ Ans.

(4) What must you multiply 1·0$\dot{6}$ by to make the product ·2014?

Here dividend ·2014 and divisor 1·0$\dot{6}$ are given.

·2014 ÷ 1·0$\dot{6}$
= $\frac{2014}{10000} \times \frac{90}{96}$ = ·1888125. Ans.

(GIRLS.)

(1) If £100 gains £3 10s. in 10 months, what will gain £21 in 15 months?

£3$\frac{1}{2}$: 21 :: 100 : 400. Ans.
mos. 15 : 10

(2) A school is open eight times in the week, and the numbers attending each time are 109, 115, 94, 103, 98, 113, 117 and 89. What is the average attendance?

(109 + 115 + 94 + 103 + 98 + 113 + 117 + 89) ÷ 8
= 106. Ans.

(3) I lost 20s. on goods sold at 32s. 6d., what was the prime cost?

32s. 6d. + 20s. = £2 12s. 6d. Ans.

(4) A dress cost £3 12s. 1d. Fifteen per cent. of this amount was for making; what was the cost of the material?

100 : 85 :: £3 12s. 1d. : £3 1s. 3$\frac{1}{4}$d. Ans.

Algebra.

(FIRST STAGE.)

(1) If $a = 1$, $b = 2$, $c = 3$, $d = 4$, $e = 5$, $f = 0$, find the value of

$abc^2 + bca^2 - dea^2 + f^3$
= 1.2.3.3 + 2.3.4.4 − 4.5.1.1 + 0
= 18 + 96 − 20 + 0
= 94. Ans.

(2) Add $x^3 - 2ax^2 + a^2x + a^3$, $x^3 + 3ax^2$, $-2x^3 - ax^2 + 2a^3$.

Ans. $a^2x + 3a^3$.

(3) From $7x^3 - 2x^2 + 2x + 2$ take $4x^3 - 2x^2 - 2x + 14$.

Ans. $3x^3 + 4x - 12$.

(4) Multiply $x^3 - 7x^2 + 5x + 1$
By $2x^2 - 4x + 1$

$2x^5 - 14x^4 + 10x^3 + 2x^2$
$- 4x^4 + 28x^3 - 20x^2 - 4x$
$x^3 - 7x^2 + 5x + 1$
$2x^5 - 18x^4 + 39x^3 - 25x^2 + x + 1.$

(5) Divide $x^4 + x^3 - 9x^2 - 16x - 4$ by $x^2 + 4x + 4$.

$x^2 + 4x + 4)x^4 + x^3 - 9x^2 - 16x - 4(x^2 - 3x - 1.$
$x^4 + 4x^3 + 4x^2$
$- 3x^3 - 13x^2 - 16x$
$- 3x^3 - 12x^2 - 12x$
$- x^2 - 4x - 4$
$- x^2 - 4x - 4$

Singing.

(UPPER DIVISION.)

Sight tests (written on blackboard).

(1) **d s d r m d f r s s d^1**
(2) **d m d r t$_1$ d s s d t$_1$ r d m d**

Time test (written on blackboard).

| 1 : 1 : 1 | 1 : : | 1 :-:- | 1 : : 1 ‖.

Modulator test.

l d^1 m^1 d^1 l m l t d^1 t l se l m l.

Publications Received.

Blackie and Son—
Clarkson's Test-Cards. Standards II. to VII.

Burns and Oates—
Practical Geometry for Art Students. By J. Carroll.

Chambers (W. and R.)—
Chambers's Advanced Reader.
Chambers's Graduated Primer. Parts 1 and 2.
French Course. Second Year. By A. Jules Dubourg, F.E.I.S.

Heywood (John)—
Analysis of the Gospel of St. Luke. By L. Hughes, B.A.
The Combined Writing and Rudimentary Drawing Copy Book. Standard III. No. 8.

Hodder and Stoughton—
Then and Now. By Lina Orman Cooper.
The Cathedral Cave. " "

Jarrold and Sons—
Occupations and Occupation Games for Infant Classes.
The Young England Copy Books. Nos. 1 to 13.

Johnston (A.)—
The Minerva Drawing Examples for Class Teaching. By William McDougall.

Johnston (W. and A. K.)—
Johnston's Map of India (with Handbook).

Moffatt and Paige—
Brown Studies. By Aaron Watson. Illustrated.

Philip (G.) and Son—
Philips' Standard Map Drawing Books. No. 1. England and Wales.

Relfe Bros.—
First Year of Scientific Knowledge. By Paul Bert.

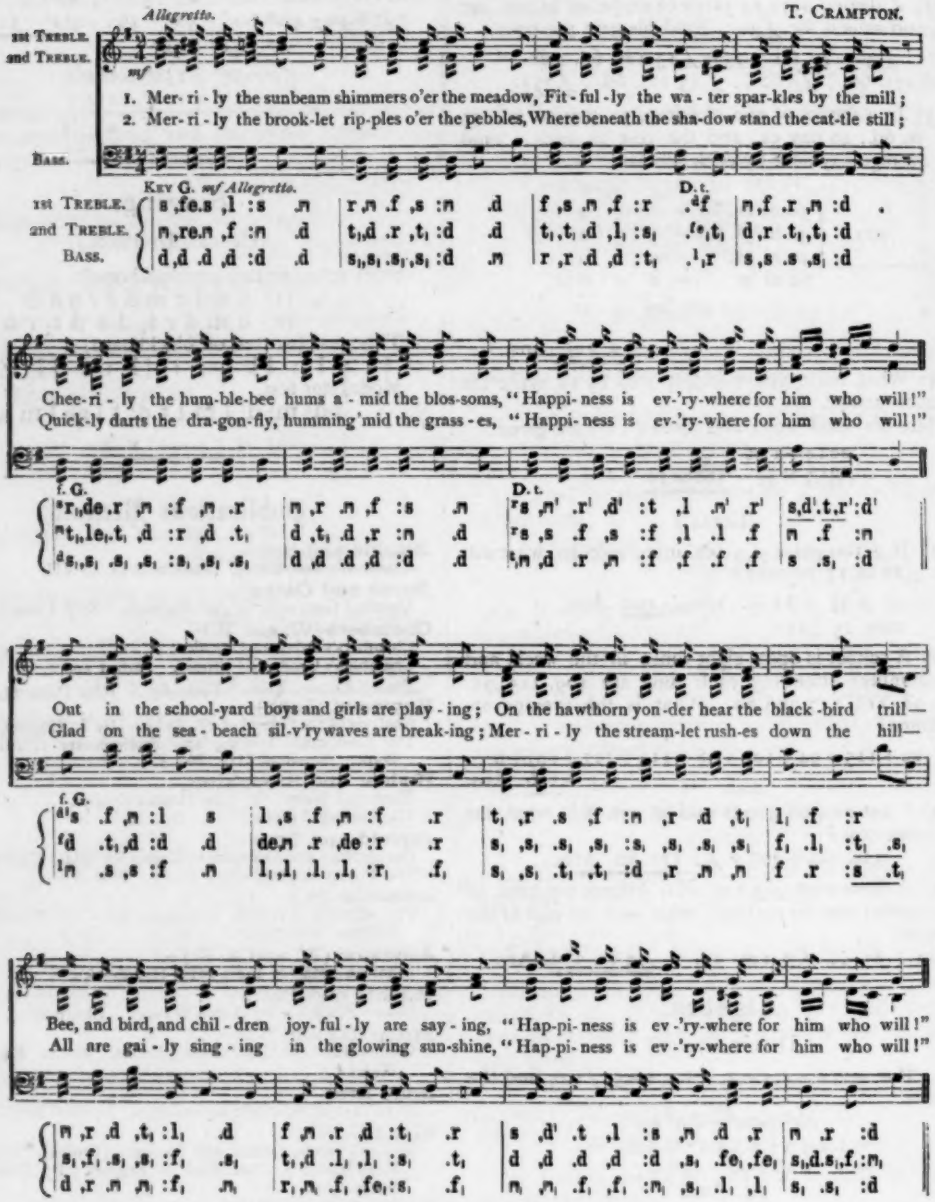
Rice (W.)—
Mother's Songs, Games, and Stories. (Fröbel's 'Mutter-und Kose-Lieder'). Rendered in English. By Frances and Emily Lord.

Smith, Elder and Co.—
The Cornhill Magazine. September.

Swan Sonnenschein and Co.—
An Elementary Star Atlas. By the Rev. T. H. E. C. Espin, B.A., F.R.A.S.

Thom Alexander and Co., Limited—
Arithmetic. By A. G. Blake, M.A.
Writing Copy Books. By A. Thom. Nos. 1 to 9.
Drawing Books. By A. Thom. Nos. 1, 2, and 3.

MERRILY THE SUNBEAM.

T. Crampton.

Allegretto.
1st Treble.
2nd Treble.
mf
1. Mer- ri - ly the sunbeam shimmers o'er the meadow, Fit - ful - ly the wa - ter spar-kles by the mill ;
2. Mer- ri - ly the brook-let rip-ples o'er the pebbles, Where beneath the sha-dow stand the cat-tle still ;
Bass.
Key G. mf Allegretto.
D. t.
1st Treble.
2nd Treble.
Bass.
Chee-ri - ly the hum-ble-bee hums a - mid the blos-soms, "Happi- ness is ev-'ry-where for him who will!"
Quick-ly darts the dra-gon-fly, humming 'mid the grass - es, "Happi- ness is ev-'ry-where for him who will!"
f. G.
D. t.
Out in the school-yard boys and girls are play - ing ; On the hawthorn yon-der hear the black -bird trill—
Glad on the sea - beach sil-v'ry waves are break-ing ; Mer - ri - ly the stream-let rush-es down the hill—
f. G.
Bee, and bird, and chil - dren joy- ful - ly are say - ing, "Hap-pi- ness is ev -'ry-where for him who will!"
All are gai - ly sing - ing in the glowing sun-shine, "Hap-pi- ness is ev -'ry-where for him who will!"

Completion of a Lesson on the Formation of Valleys and Hills.

BY JOS. H. COWHAM, F.G.S.,
Westminster Training College.

LESSON II.

INFORMATION AND ITS ARRANGEMENT.

1. **Introduction.**

In Lesson I. the formation of channels on a small scale after heavy showers was explained. The continued action of running water upon a level area was then observed to change that area into one crossed by minute valleys and intervening high land.

2. **Operations continued beyond the range of simple observation requiring efforts of imagination and inference.**

(*a*) The water-course, if long continued, scoops out a deep channel.

(*b*) At the same time the sides of the channel are worn down, and thus a gentle slope is formed, extending from the high land towards the bed of the river.

(*c*) When these slopes extend long distances on either side of the valley fresh water-courses are formed along them.

(*d*) These water-courses scoop out new valleys, which frequently run at right angles to the direction of the parent valley.

TERMS: The hollows formed along the side slopes of an old valley are termed SECONDARY VALLEYS. The streams in these secondary valleys are generally TRIBUTARIES. They are tributaries of the river draining the first formed or PRIMARY VALLEY.

3. **Examples of valleys in England formed mainly by water-action.**

(*a*) The valleys, called '*dales*,' on the east and west slopes of the Pennine Range. The rivers which have formed these northern dales are (1) the Tyne, Wear, and Tees, in *Durham;* (2) Ure, Nidd, Wharfe, Aire, Calder, and Don, in *Yorkshire;* (3) the Eden, Lune, Ribble, and Mersey, *on the west.*

ILLUSTRATIONS, EXAMPLES, Etc.

These facts will readily be recalled by the aid of the models and diagrams used in Lesson I. (See PRACTICAL TEACHER *for September.*)

A good foundation of observed results will thus be laid, upon which the higher mental operations required in this lesson may be based.

(*a*) and (*b*).

Fig. 1. Section across a valley. The width of the valley is about 2½ miles. Most localities present examples of valleys similarly formed.

The observation made of the hollow formed in the playground by the runnel during a heavy shower must be recalled. The same force at work during many years has scooped out the valley in the sketch.

(*c*) and (*d*).

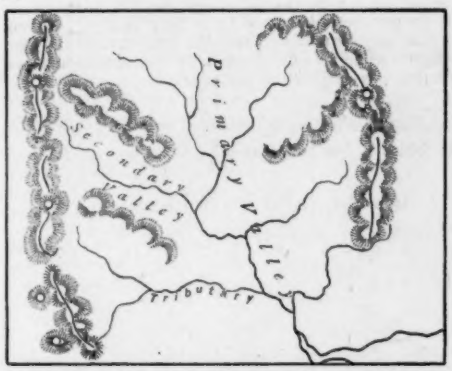


Fig. 2. Sketch-map showing a primary valley, and several secondary valleys, with intervening ridges of hills.

NOTE.—The valleys running westward from the Cotswolds into the Severn are examples of *secondary* valleys entering a *primary* valley.

(*a*) A sketch-map of the six northern countries, showing the distribution of hill ranges and streams, will sufficiently illustrate this information.

N.B.—For young children, a model roughly moulded in moist sand will be very helpful.

(*b*) In the South of England the Thames has carved a beautiful valley, and its many tributaries have hollowed out the secondary valleys they drain.

(*b*) Allow the class from an ordinary wall-map to select primary and secondary valleys in the Thames basin.

N.B.—Revisions follow each chief heading. A complete review of both lessons may be taken at the close.

Pupil Teachers' Examination Papers,

WITH ANSWERS.

FIRST YEAR.

Pupil Teachers at end of First Year.

Three hours and a half allowed.

Arithmetic.

MALES.

1. Express ·142857 and ·342753 as vulgar fractions, and convert $(\frac{1}{3}-\frac{1}{7})\times(\frac{2}{3}+1\frac{1}{2})$ into a decimal fraction. Why is the recurring decimal ·9 considered equal to 1?

$$\cdot142857=\tfrac{142857}{999999}=\tfrac{1}{7}.$$

$$\cdot342753=\frac{342753-342}{999000}=\tfrac{342411}{999000}=\underline{\tfrac{114137}{333000}}.$$

$$(\tfrac{1}{3}-\tfrac{1}{7})\times(\tfrac{2}{3}+1\tfrac{1}{2})$$
$$=\frac{(9-4)}{36}\times2\tfrac{1}{12}$$
$$=\tfrac{5}{36}\times\tfrac{25}{12}$$
$$=\tfrac{7}{144}$$
$$=\underline{\cdot2916}.$$

·9 is considered = 1 because although the diff. between ·9 and 1 = ·1, yet that between ·99 and 1 is only ·01 and between ·999 and 1 is only ·001, so that the diff. becomes less and less the more figures we take in the decimal, and its value approaches nearer to 1 than any value which can be stated.

2. Find a fraction which when subtracted from $4\frac{3}{7}$ of $\frac{7}{15}$ leaves a remainder which is less by $\frac{2}{5}$ than $2\frac{1}{6\frac{1}{4}}$.

$$(4\tfrac{3}{7}\times\tfrac{7}{15})-\left(2\frac{1}{6\frac{1}{4}}-\tfrac{2}{5}\right)=\text{the fraction}$$
$$=(\tfrac{30}{7}\times\tfrac{7}{15})-(2\tfrac{4}{13}-\tfrac{2}{5})$$
$$=2-(\tfrac{24}{13}-\tfrac{2}{5})$$
$$=2-\left(\frac{465-129}{215}\right)$$
$$=2-\tfrac{336}{215}$$
$$=\underline{\tfrac{94}{215}}.\quad\text{Ans.}$$

3. Find the number of gallons in a ton of water if a cubic foot of water weighs 1000 ozs., and a gallon contains 277·274 cubic inches.

oz.		ton.		c. ft.		ft.
1000	:	1	::	1	:	x
=1000	:	35840	::	1	:	35·84
inches.		ft.		gall.		galls.
277·274	:	35·84	::	1	:	x

$$=\underline{223\cdot358\ldots}\quad\text{Ans.}$$

4. If $\frac{3}{11}$ of a guinea be taken from $\frac{3}{17}$ of $\frac{5}{8}$ of £5 what fraction of £3 9s. will remain?

$$\frac{(\frac{3}{11}\times\frac{5}{8}\times\frac{5}{1})-(\frac{7}{11}\text{ of }\frac{3}{14})}{3\frac{9}{11}}$$
$$=(\tfrac{75}{88}-\tfrac{15}{154})\div\tfrac{42}{11}$$
$$=\frac{2500-1764}{3600}\times\tfrac{11}{42}$$
$$=\tfrac{736}{3600}\times\tfrac{11}{42}$$
$$=\underline{\tfrac{1}{15}}.\quad\text{Ans.}$$

FEMALES.

1. Find by Practice the value of 17 lbs. 7 dwt. 12 grains of silver at 5s. 6d. per oz.

17 lbs. = 204 oz.

	£	s.	d.		
5 dwt. = $\frac{1}{4}$ oz.	0	5	6	= value of 1 oz.	
		204			
	56	2	0	= ,,	204 oz.
1 dwt. = $\frac{1}{5}$ of 5	0	1	$4\frac{4}{5}$	= ,,	5 dwt.
1 dwt. = $\frac{1}{5}$ of 5	0	0	$3\frac{3}{10}$	= ,,	1 ,,
12 grs. = $\frac{1}{2}$ of dwt.	0	0	$3\frac{3}{10}$	= ,,	1 ,,
	0	0	$1\frac{1}{20}$	= ,,	12 grs.
	£56	4	$0\frac{3}{4}$	= ,,	17 lbs. 7 dwt. 12 grs.

2. What will my net income be after paying 1s. 4d. in the pound income tax on £1191 3s. 9d.? Find the tax by practice.

	£	s.	d.	
1s. 4d. = $\frac{1}{15}$ of £1	1191	3	9	= gross income
	79	8	3	= income tax
£	1111	15	6	= net income.

3. Explain the terms *Multiple*, *Common Multiple*, and *Least Common Multiple*, and say what is the least sum of money which will contain 2s. 6d., 3s. 6d., 4s. 6d., and 5s. 6d.

A multiple is a number which will contain another any number of times without a remainder, thus 24 is a multiple of 3, or 4, or 6, or 12.

A common multiple is a number which will contain each of two or more numbers without a remainder, thus 24 is a common multiple of 3, 4, 6, and 12.

The least common multiple is the least number which will contain two or more numbers, thus 12 is the L.C.M. of 2, 3, 4, and 6.

2s. 6d., 3s. 6d., 4s. 6d., 5s. 6d.
= 5 7 9 11 sixpences.
L.C.M. of 5, 7, 9, 11 = 3465.
3465 sixpences = £86 12s. 6d.

4. Add together $\frac{6}{11}$, $6\frac{1}{11}$, and $\frac{6}{11}$ of $6\frac{1}{11}$, and say what fraction is required to make the sum 10.

$$10-(\tfrac{6}{11}+6\tfrac{1}{11}+\tfrac{6}{11}\text{ of }6\tfrac{1}{11})$$
$$=10-(\tfrac{6}{11}+6\tfrac{1}{11}+\tfrac{6}{11}\times\tfrac{67}{11})$$
$$=10-\left(9\frac{66+11+39}{121}\right)$$
$$=10-9\tfrac{116}{121}$$
$$=\underline{\tfrac{5}{121}}.\quad\text{Ans.}$$

Grammar.

MALES AND FEMALES.

1. Parse the words in italics in the following passage, and analyse the passage fully.

Now *blooms* the *lily* by the bank,
The *primrose* down the brae,
The *hawthorn's budding* in the glen,
And *milk-white* is the slae;
The meanest hind in fair Scotland
May rove their sweets *amang*,
But I, the *Queen* of a' Scotland,
Maun lie in prison strang.

Blooms—reg. intrans. verb, act., ind., pres., sing., 3rd., agreeing with its nom. *lily*.

lily—com. noun, neut., sing., 3rd, nom. to *blooms*.

primrose—com. noun., neut., sing., nom. to *blooms*, und.

hawthorn—com. noun, neut., sing., nom. to *is blooming*.

is—aux. verb to *budding*.
budding—pres. part. to *bud*, ref. to *hawthorn*.
is budding—reg. int verb, act., ind., pres., prog. sing., 3rd, agreeing with *hawthorn*.
milk-white—comp. adj. of qual., qual. *slae*.
may—aux. verb to *rove*, indicating pot. mood, pres. tense.
rove—reg. intrans. verb, act., inf., pres., gov. by *may*.
may rove—reg. intrans. verb, act., pot., pres., 3rd, sing., agreeing with *hind*.
amang—prep., showing rel. bet. *sweets* and *may rove*.
Queen—common noun, used as proper, fem., sing., 1st, in app. with *I*.
maun = must—aux. verb to *lie*, ind. pot. mood, pres. tense.
lie—irreg. intrans. verb, act., inf., pres., gov. by *maun*.
maun lie—irreg. intrans. verb, act., pot., pres., 1st, sing., agreeing with *I*.

ANALYSIS.

Sentence.	Kind of Sent.	Connective.	Subject.	Predicate.	Objct.	Extension.
(*a*) Now blooms the the lily by the bank	Prin. Sent.		the lily	blooms		by the bank (place) now (time)
(*b*) the primrose down the brae	Prin. Sent.		the primrose	[blooms]		down the brae (place)
(*c*) the hawthorn's budding in the glen	Prin. Sent.		the hawthorn	is budding		in the glen (place)
(*d*) the meanest hind in fair Scotland may rove their sweets amang	Prin. Sent.		the meanest hind in fair Scotland	may rove		amang their sweets (place)
(*e*) But I, the Queen of a' Scotland, maun lie in prison strang	Prin. Sent.	but	I, the Queen of a' Scotland	maun lie		in prison strang (place)

2. What is the signification of the affixes in the following words:—Forty, weaken, girlish, pocket, finery, whiteness. Give other examples.

Termination.	Meaning.	Other Examples.
—ty	ten: multiplied by ten.	sixty, eighty, ninety.
—en	to make or give.	strengthen, sweeten, darken.
—ish	somewhat like, a little of.	peevish, foolish, rakish.
—et	a diminutive.	locket, socket, latchet.
—ry	denoting state.	husbandry, masonry, chivalry.
—ness	state of being.	goodness, sourness, sweetness.

3. Make nouns by putting affixes to the following words:—Sail, pun, dear, true, laugh, gird, stream, ward.
Sailor, punster, dearth, truth, laughter, girdle, streamlet, warden.

Geography.

(*Answer two questions, one of which must be Question* 1.)

1. Draw a map of the East coast of Scotland, *or* of the Province of Ulster. Insert lines of latitude and longitude.

2. Write a description of Northumberland, Argyleshire, or Connaught. Illustrate your answer by a map.

Northumberland is the most northerly county in England, and forms a part of the ancient Saxon kingdom of Northumbria, 'land north of the Humber.' It is separated from Scotland by the Tweed and the Cheviots, from Cumberland by the Pennine range, and from Durham by the Tyne and Derwent. Its area is about 1950 square miles, and its population 400,000. The Cheviots are almost treeless, but afford pasturage for great numbers of sheep. The Pennine range contains valuable mines of lead. Coal is abundant in the Eastern part of the county. The surface generally is hilly, especially towards the West, but is suitable for cultivation in the valleys of the Till, Coquet, Aln, and Tyne. Off the coast are the Farne, Coquet, and Holy Is. The chief towns are Newcastle, Tynemouth, Alnwick, Hexham, Morpeth, Blyth, and Berwick. The banks of the Tyne are covered with manufactories of iron, glass, and chemicals, and shipyards, docks, and coal staiths.

Argyleshire is the second largest county in Scotland, and includes all the land between the Firth of Clyde and Loch Linnhe, besides the islands of Mull, Islay, and Jura. Inverness bounds it on the north, Perth and Dumbarton on the east, and the Atlantic on the west. It covers 3250 square miles, but is sparsely populated, except on the Firth of Clyde. Its west coast is deeply indented, the most important openings being Loch Linnhe, Loch Etive, Loch Fyne, Loch Tarbert, and Loch Long. Part of the mainland forms the peninsula of Cantire. The surface is mountainous, Ben Cruachan being 3670 feet. The scenery is grand and picturesque, the soil in the deep valleys is fertile, and cattle rearing and sheep farming the chief occupation of the people. Slate is obtained in large quantities at Ballachulish, and the fisheries, especially of Loch Fyne, are important. Inverary is the capital, but Dunoon is the largest town. Oban is a celebrated centre for tourists, and Tarbert, Inellan, and Lochgoilhead are other towns.

Connaught is one of the four provinces of Ireland, and includes the counties of Galway, Mayo, Sligo, Leitrim, and Roscommon. It is the least improved district of Ireland. Its shores are greatly indented, Galway Bay, Clew Bay, Killala Bay, and Sligo Bay being the principal openings. The surface of the province is very mountainous in the west, the Connemara highlands being wild and rugged in the extreme. It is much flatter in the east. The river Shannon, which flows through Loughs Allen, Ree, and Derg, is its eastern boundary; and Loughs Corrib, Mask, and Conn are situated in the western part of the province. The people of the west are engaged in fisheries; inland they rear cattle. The chief towns in the province are Galway (with a Queen's College), Tuam (the seat of an archbishopric), Sligo, Leitrim, and Carrick-on-Shannon.

3. Give a detailed description of New South Wales, and its advantages as a colony.

New South Wales covers 310,000 square miles of the surface of the south-east portion of Australia. On the north it is bounded by Queensland, on the south by Victoria (formerly a part of the colony) and the Murray River; west by South Australia (the 141st meridian E.), and east by the Pacific. The high lands run parallel with the coast, Mount Kosciusko in the Australian Alps being the highest point (7300 feet). The tributaries of the Murray, the Darling, Lachlan, and Murrumbidgee drain the colony, flowing generally in a south-westerly direction to join the main stream in the south. Along the banks of these streams and occupying the whole of the interior of the colony are the immense pastoral lands which find food for many millions of sheep and cattle, while the mountains yield gold, silver, copper, lead, tin, zinc, and iron. Near the mouth of the Hunter River coal is very abundant, Newcastle being the chief coal-mining centre. Sydney, beautifully situated on Port Jackson, is the capital, and Bathurst, Paramatta, Picton, Port Macquarie, and Tamworth are thriving towns. Its advantages as a colony are superior, it having many industries, which are carried on in a varied but salubrious and agreeable climate; its government is democratic, education is free, and perfect religious equality exists.

History.

1. What steps were taken by the Romans to protect the northern part of England from invasion during their occupation of this country?

Julius Agricola, who was the first Roman general who actually subdued Britain, built a chain of forts from the Tyne to the Solway Firth, in A.D. 79, and in A.D. 81, a similar line of forts from the Clyde to the Forth. Unable to hold the northern forts, the Emperor Adrian constructed a ditch and rampart of earth on the line of Agricola's forts. In A.D. 139, a similar rampart was built along the line of the northern forts in the reign of Antoninus Pius. The Emperor Severus in 211 built a strong stone wall on the line of Adrian's wall, and strengthened it with a large garrison. Parts of this stone wall still remain in excellent preservation.

2. Give a short account of the government of Alfred the Great.

Alfred was as energetic in the government of his country as he was brave in fighting her battles. He collected a number of laws for the benefit of his people. He established a fleet, and tried to revive the sea-faring spirit of previous ages. He put the military forces of the kingdom in better order to guard against future invasions. He maintained great numbers of poor, and endowed many churches. He founded monasteries and schools, and encouraged learned foreigners to settle in the country. He translated parts of the Bible and other books into English for the use of the people. He promoted commerce and intercourse with foreign countries, sending embassies to Italy, to Jerusalem, and to India. He punished wrong-doing severely, and crime under his rule became very rare. Trial by jury was established, and the country was divided into districts or these districts were more clearly defined for the purpose of more effectually governing it easily and well.

3. How were the Norman dukes connected with the Saxon kings?

Emma, the daughter of Richard the Fearless, married Ethelred II., king of England, and became the mother of Edward the Confessor. William the Conqueror was the son of Robert the Magnificent, her nephew.

Composition.

Write from memory the substance of the following passage read to you by the inspector.

As an instance of the affection existing between a boy and his parent, the following story is told. During the French Revolution, a lady and her daughter, together with her son, a lad of fifteen, were confined in prison, and ultimately brought to trial. The mother and daughter were condemned to death, but little notice was taken of the son, except that he was sent back to prison. 'What,' said he, 'am I thus to be separated from my mother? It must not be,' and instantly shouted, '*Vive le Roi!*' He was then immediately sentenced to death, and was led out to execution with his mother and sister.

Needlework.

FEMALES.

One hour allowed for this exercise.

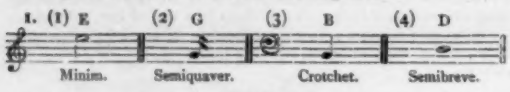
Music.

OLD NOTATION.

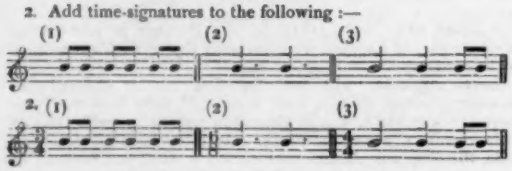
A quarter of an hour allowed for this paper.

(N.B.—Pupil Teachers may answer the questions in either the Staff Notation or the Tonic Sol-fa, but *not both*. The questions in the Tonic Sol-fa Notation will be found at the end.)

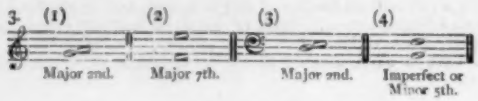
1. Write the pitch-name (C, D, &c.) above, and the value-name (quaver, &c.) below, of the following notes :—



2. Add time-signatures to the following :—



3. Write below each of the following intervals its name (major 3rd, &c.) :—



TONIC SOL-FA NOTATION.

1. Re-write the following exercise, doubling the value of every note :—

|m .m :d |d .d :r .f |m :— |

1.

|m :m |d :— |d :d |r :f |m :— |— :— |

2. What are the intervals from :—(*a*) *soh* to lah_1; (*b*) *fah* to me^1; (*c*) *ray* to *me*; and (*d*) *te* to *fah*?

2. (*a*) Major 2nd; (*b*) Major 7th; (*c*) Major 2nd; (*d*) Imperfect or Minor 5th.

3. What note of the scale would be the *tonic* in (*a*) "Key F"; (*b*) in "Key A."

3. (*a*) *fah*; (*b*) *lah*.

—o—

SECOND YEAR.

Pupil Teachers at end of Second Year.

FIRST PAPER.

Three hours and a half allowed.

Euclid.

MALES.

[All generally understood abbreviations for words may be used.]

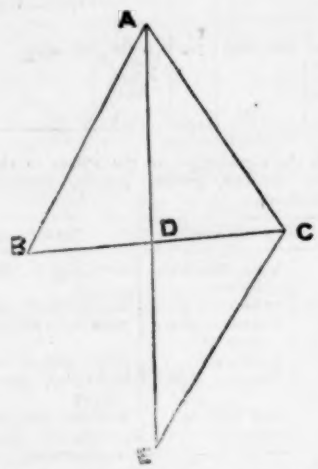
1. The angles at the base of an isosceles triangle are equal.—What proposition is the converse of this?

Euclid, Book I., prop. 5, first part.—Prop. 6.

2. If two triangles have two angles of the one equal to two angles of the other each to each, and one side equal to one side—viz., the sides opposite to equal angles in each, then their other sides shall be equal, the two triangles shall be equal, and the third angle of the one shall be equal to the third angle of the other.

Euclid, Book I., prop. 26, second part.

3. The two sides of a triangle are together greater than twice the straight line drawn from the vertex to the middle point of the base.



In the $\triangle$ ABC let the line AD be drawn from the vertex A to D, the middle point of the base BC. BA, AC shall together be > twice AD.

Produce AD to E. Make DE=AD. Join CE.

Because AD=DE, and CD=DB (constr.) and $\angle$ ADB= $\angle$ CDE (I. 15). $\therefore$ AB=CE (I. 4). And AC, CE are together >AE, which is twice AD. $\therefore$ AC, AB are together > twice AD. Q. E. D.

Arithmetic.

FEMALES.

1. Find the sum of the greatest and least of the fractions $\frac{7}{11}$, $\frac{11}{22}$, $\frac{13}{23}$, $\frac{3}{5}$; the sum of the other two, and the difference of these sums.

$\frac{7}{11}, \frac{11}{22}, \frac{13}{23}, \frac{3}{5} = \frac{20930, 13915, 14300, 13156}{32890}$

∴ Greatest is $\frac{7}{11}$ and least $\frac{3}{5}$.

$$= \left(\frac{35+22}{55}\right) - \left(\frac{253+260}{598}\right)$$
$$= \frac{57}{55} - \frac{513}{598}$$
$$= \frac{34086 - 28215}{32890}$$
$$= \frac{5871}{32890}. \text{ Ans.}$$

2. If $7\frac{3}{4}$ yds. cost £7 18s. 4d., how much will $49\frac{5}{11}$ yds. cost?

£7 18s. 4d. = £$7\frac{11}{12}$

$7\frac{3}{4} : 49\frac{5}{11} :: 7\frac{11}{12} : x$

$$= \frac{\overset{1}{31}}{\underset{1}{4}} \times \frac{\overset{49}{544}}{\underset{11}{11}} \times \frac{\overset{7}{95}}{\underset{12}{12}}$$
$$= \frac{1666}{11}$$
$$= £51\ 3s.\ 1\tfrac{5}{11}d. \text{ Ans.}$$

3. Reduce 4s. $7\frac{1}{2}$d. to the fraction of 5s. 9d., and 4 cwt. 57 lbs. to the fraction of $1\frac{3}{4}$ qrs.

$$\frac{4s.\ 7\frac{1}{2}d.}{5s.\ 9d.} = \frac{55\frac{1}{2}}{69} = \frac{111}{138} = \frac{37}{46}. \text{ Ans.}$$

$$\frac{4 \text{ cwt. } 57 \text{ lbs.}}{1\frac{3}{4} \text{ qr.}} = \frac{505}{49} = 10\tfrac{15}{49}. \text{ Ans.}$$

(4). If four men have a sum of money divided among them, so that A has $\frac{1}{3}$ of it, B $\frac{1}{4}$, C $\frac{1}{6}$, and D the remainder, which is £28, what is the sum?

$$1 - (\tfrac{1}{3} + \tfrac{1}{4} + \tfrac{1}{6})$$
$$= 1 - \left(\frac{4+3+2}{12}\right)$$
$$= \tfrac{1}{12}, \text{ D's share.}$$
$$\tfrac{1}{12} = £28;$$
$$\tfrac{12}{12} = £112. \text{ Ans.}$$

Grammar.

MALES AND FEMALES.

1. Paraphrase and analyse the following passage, and parse the words in italics:—

'*Honour, that praise which* real merit gains,
Or e'en imaginary worth obtains,
Here *passes current*.'—GOLDSMITH.

That form of reward which is given in most places to those who possess qualities worthy of praise, and which is also bestowed upon those whose title to it is not so valid, is here given freely by the people one to the other.

Sentence.	Kind of Sentence.	Con.	Subj.	Pred.	Object.	Exten.
(*a*) Honour that praise passes current here	Princ. Sent.		Honour that praise	passes current		here (place)
(*b*) Which real merit gains	Adj. Sent. to praise in *a*.	in rel. pro.	real merit	gains	which	
(*c*) Or even imaginary worth obtains	Adj. Sent. to praise in *a*.	or	imaginary worth	obtains	[which]	

Honour—abs. noun, neut., sing., nom. to *passes*.
that—adj. of distinction, pointing out *praise*.
praise—abs. noun, neut., sing., nom. in app. with *honour*.
which—rel. pro., agr. with its antecedent 'praise,' neut., sing., 3rd, obj., gov. by *gains*.
or—conj., joining the sents., 'Real merit gains' and 'Imaginary worth obtains.'
even—adv. of deg., qualg. *obtains* (=equally).
passes—reg. intrans. verb, act., ind., pres., 3rd, sing., agreeing with *honour*.
current—adj. of quality, qual. *honour*.

2. Make a list of the prefixes in the following words, giving their meanings and the meaning of the words:—Antecedent, adjective, conjunction, preposition, interjection, objective, adverb, pronoun.

Word.	Prefix.	Meaning of Prefix.	Meaning of Word.
antecedent	ante-	before	Going before; the word to which relative pronouns refer is so-called.
adjective	ad-	to	A word joined to a noun to qualify it.
conjunction	con-	together	A word which joins together other words or sentences.
preposition	pre-	before	A word placed before a noun to show its relation to other words.
interjection	inter-	between	A word thrown in to express emotion.
objective	ob-	in the way of	The case of the object; that which is thrown in the way of, or follows a transitive verb.
adverb	ad-	to	A word added to a verb.
pronoun	pro-	for	A word used for or instead of a noun.

3. Give Latin derivatives in which the following affixes are used: -ant, -ose, -ate, -escent, -esce, -esque, -ical, -ique, -ian, -ary.

-ant, elegant, dormant.
-ose, grandiose, verbose.
-ate, sedate, associate.
-escent, opalescent, convalescent.
-esce, coalesce.
-esque, picturesque, statuesque.
-ical, problematical, nautical.
-ique, unique, oblique.
-ian, Christian, politician.
-ary, antiquary, solitary.

Geography.

(*Answer one question, and draw one map.*)

1. Draw a map of one of the following:—
(*a*) The Baltic Sea.
(*b*) France.
(*c*) Italy.

2. Enumerate the changes made in the East of Europe by the Berlin Congress, and briefly describe the chief physical features of Turkey.

Montenegro, Servia, and Roumania, hitherto subject to Turkey, were made into independent principalities. Bulgaria was left tributary to Turkey, but allowed a Christian government and a militia of its own. To Russia, part of Bessarabia was given by Roumania; which received in return a part of the Dobrudscha along the Black Sea. Servia was enlarged by the addition of the upper part of the Valley of the Morava.

The Alps, after leaving Transylvania, are continued through Turkey under the name of the Balkan range, which extends right across the country to the Black Sea. Towards the centre of the country is the great mass called Tchar Dagh (10,000 ft.). South-west of the Balkans is the Despoto Dagh, and to the south the Pindus range which runs into Greece. These mountains are crossed by narrow defiles, one of the most noted being the Schipka Pass. The lower course of the Danube, the Maritza, flowing into the Black Sea; the Struma, Solombria, and Vardar, into the Archipelago; and Doin and Boyana, into the Adriatic, are the principal rivers. Turkey may be said to be a mountainous country, but there are extensive flat districts which are very fertile: as the plain of the Lower Danube, the valley of the Maritza, and the Plain of Thessaly. Turkey is washed by the Adriatic, the Archipelago, the Sea of Marmora, and the Black Sea, and has numerous islands in the Archipelago.

3. Name the chief towns of Italy, and state briefly for what each is noted.

Rome—capital, on Tiber, celebrated for its fine modern buildings (St. Peter's and Vatican) and its ancient ruins (Colosseum and Arch of Titus).

Naples—largest and most beautifully situated city in Italy,

trade, growth of vine, Pompeii and Herculaneum and Vesuvius near.

Turin—on Po, silk manufacture.

Genoa—port, exports olive oil, silk, fruits.

Milan—fine cathedral, silk trade extensive.

Venice—built on islands; manufactures glass and jewellery, shipbuilding; Cathedral of St. Mark, Rialto Bridge and Bridge of Sighs.

Bologna—manufactures glass, silk, and musical instruments.

Florence—beautiful city, many paintings and sculptures. Birthplace of Dante, Michael Angelo, Galileo, Boccacio, Petrarch, etc.

Mantua—a fortified town and considerable trade.

Leghorn—port, exports straw hats, silk, olive oil, fruits, and wine.

Pisa—university, leaning tower.

Gaeta—strongly fortified.

Brindisi—packet station.

Parma, *Ferrara*, *Padua*, *Bari*, *Pavia*, and *Ravenna* are considerable towns.

SECOND PAPER.

Two hours and a half allowed.

Needlework.

FEMALES.

The needlework specimens will be collected one hour after the distribution of the Examination paper.

Arithmetic.

MALES.

1. What is the discount on a bill for £793 14s. 10½d., due nine months hence, at 4 per cent.?

Int. on £100 for 9 mos. at 4 per cent = £3.

£	£	£	s.	d.	£	s.	d.
∴ 103	: 3	:: 793	14	10½	: 23	2	4½. Ans.

2. My income amounts to £69 6s. 6½d. annually, derived from an investment in 5 per cent. Railway Debentures. This money was the amount of an investment 2¼ years previously at 3½ per cent. simple interest. Find the original sum.

£	£	s.	d.		£		£	s.	d.
5	: 69	6	6½	::	100	:	1385	11	3

£100 in 2¼ yrs. at 3 per cent. = 100 + (2¼ × 3) = 106¾

£		£		£	s.	d.		£
106¾	:	100	::	1380	11	3	:	1275. Ans.

3. A herd of 240 cows were sold at £14 6s. each, and the buyer paid $\frac{1}{11}$ of their cost for carriage to the market, where he exchanged them for 299 ponies at £15 each. What was his gain per cent.?

£14 6s. × 240 = £3432 original cost

$\frac{1}{11}$ of £3432 = 156 carriage

£3588 Total expenditure.

£15 × 299 = £4485 value of ponies

£4485 − £3432 = £897 gain

∴ £3588 : £100 :: £897 : £4 gain per cent.

4. By investing a certain sum in the 3 per cent. Consols at 93, my income is less by £21 12s. than it would be if I had invested in £100 railway shares selling at 132 and paying £6 per share. How much have I invested?

In 3 per cent. consols, £1 will yield $\frac{3}{93}$

" 6 " railway shares " $\frac{6}{132}$

Diff. $= \frac{6}{132} - \frac{3}{93} = \frac{186 - 132}{4092} = \frac{54}{4092}$.

∴ Amount invested to yield $\frac{54}{4092}$ = £1

" " " 1 = $\frac{4092}{54}$

" " " £21 12s. = $\frac{4092}{54} \times 21\frac{3}{5}$ = £1636 16s. Ans.

History.

MALES AND FEMALES.

1. What were the chief events of the reign of Henry I.? Give the dates of the reigns of all the kings of the same name, and state to what dynasty each belonged.

	A.D.
Henry usurped the throne	1100
He proclaimed a charter of liberties abolishing curfew and Danegelt	1100
He broke the power of the barons and conquered Normandy, Robert being taken prisoner at Tenchebrai	1106
Quarrel with Anselm healed	1108
Drowning of Prince William	1120
Settlement of Flemish ... ... about	1120
Marriage of Matilda to Geoffrey Plantagenet ...	1127
Oath of fealty to Matilda...	1133
Death of Henry	1135

Henry I.	... ...	1100—1135	Norman.
Henry II.	... ...	1154—1189	Plantagenet.
Henry III.	... ...	1216—1272	"
Henry IV.	... ...	1399—1413	Lancaster.
Henry V.	... ...	1413—1422	"
Henry VI.	... ...	1422—1461	"
Henry VII.	... ...	1485—1509	Tudor.
Henry VIII.	... ...	1509—1547	"

2. Who was sovereign of England at the close of the sixteenth century? State briefly the condition of the country at that time, as to power, government, laws, religion, and commerce.

Elizabeth was Queen of England from 1558 to 1603. The country had recovered from the effects of the Wars of the Roses, and was increasing in wealth and influence. The defeat of the Spanish Armada led the people to feel themselves able to cope with even the strongest of their enemies. It aroused a patriotic spirit and desire for naval supremacy. The Government was still somewhat absolute, but the people desired greater control over the affairs of the nation, and objected strongly to the monopolies granted by Elizabeth. These she abolished near the close of the reign. The laws were administered by the Courts of Justice, the Star Chamber, and Court of High Commission. Those of Supremacy and Conformity pressed hardly upon Catholics and Nonconformists. Elizabeth was a member of the Protestant Church, and the people generally followed her lead. Many persons suffered imprisonment and death through their non-compliance with the Acts named. Trade and commerce began to flourish. The East India Company was formed. Hundreds of work-people from the Netherlands and from France settled in the country, and silk and woollen-cloth began to be manufactured.

3. Write a short account of the battle of Bannockburn.

Robert Bruce, grandson of the Bruce who had disputed with Baliol the crown of Scotland, assumed the leadership of the Scots after the death of Wallace. He was crowned at Scone, and the indignant Edward marched northward to punish him. Death, however, carried away the English king, and the enterprise was for a time abandoned by his successor, Edward II. Bruce made great headway, but when he threatened Stirling Castle, Edward marched northward with a great army. The armies met at Bannockburn, near Stirling, in June, 1314. The English army was much larger than that of Bruce, and spent the night previous to the battle in revelry and merry-making. The Scotch army of 30,000 was formed in squares and circles of spearmen, against which the English cavalry dashed in vain. Being ill-led, they were thrown into disorder and utterly routed, many falling into pits dug by the Scotch on the plain. 30,000 were left dead on the battle-field. Edward fled, closely pursued by a party of Scotch. He, however, succeeded in escaping, but all his treasures and supplies fell into the hands of his enemies. Scotland, by this battle, won her independence, and Bruce was afterwards acknowledged as king.

Teaching.

What methods would you adopt to prevent copying in Arithmetic?

Point out the wrong done by those who copy. Let this be repeated at intervals. This, however, will not always be sufficient. Prevent copying by the following means:—

(1) If engaged on the same work, by active and constant supervision.

(2) By placing those children apart who fall into the habit most.

(3) By teaching and assisting, as required, those who are unable to do their work readily.

(4) By insisting upon each child sitting in a position least favourable to copying.

(5) By having slates or papers turned over as soon as work is finished.

(6) By giving different work to different children, as often as is practicable, and whenvery close attention cannot be given to all the children in the class.

Music.

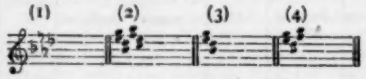
A quarter of an hour allowed for this paper.

OLD NOTATION.

(N.B.—Pupil Teachers may answer the questions in either the Staff Notation or the Tonic Sol-fa, but *not both*. The questions in the Tonic Sol-fa Notation will be found at the end.)

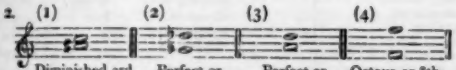
1. Write the key-signatures of the following major keys :—(1) A; (2) E ; (3) D ; (4) A.

1. (1) (2) (3) (4)



2. Write below each of the following intervals its name (major 2nd, &c.) :—

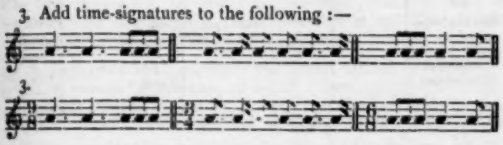
2. (1) (2) (3) (4)



Diminished 3rd. Perfect or Major 5th. Perfect or Major 4th. Octave or 8th.

3. Add time-signatures to the following :—

3.



TONIC SOL-FA NOTATION.

1. What are the names of the following intervals :—(1) *le* to *doh*^{1} ; (2) *fe* to *de* ; (3) *soh* to *doh* ; (4) *fah* to *fah*^{1}.

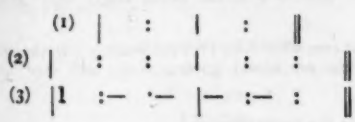
1. (1) Diminished 3rd ; (2) Perfect or major 5th ; (3) Perfect or major 4th ; (4) Octave or 8th.

2. What are the mental effects of (1) *fah* ; (2) *ray* ; (3) *lah* ?

2. (1) Desolate or awe-inspiring ; (2) expectant or hopeful ; (3) sad and mournful.

3. Write (1) a four-pulse measure ; (2) a six-pulse measure ; (3) a five-pulse tone in three-pulse measure.

3.



THIRD YEAR.

Pupil Teachers at end of Third Year.

FIRST PAPER.

Three hours and a half allowed.

Euclid.

MALES.

[All generally understood abbreviations for words may be used.]

(*Answer two Questions, including No. 3, if you can.*)

1. The complements of the parallelograms which are about the diagonal of a parallelogram are equal to one another.
Euclid, Book I., Prop. 43.

2. The interior angles of any rectilineal figure together with four right angles are equal to twice as many right angles as the figure has sides ; and the exterior angles of any rectilineal figure are equal to four right angles.
Euclid, Book I., Prop. 32, Cor. I. and II.

3. If a six-sided plane rectilineal figure have its opposite sides equal and parallel, the three straight lines joining its opposite angles will meet at a point.

Let ABCDEF be a plane rectilineal fig. with its opposite sides parallel and equal ;

Then AD, BE, CF joining its opposite angles shall meet at a point O.

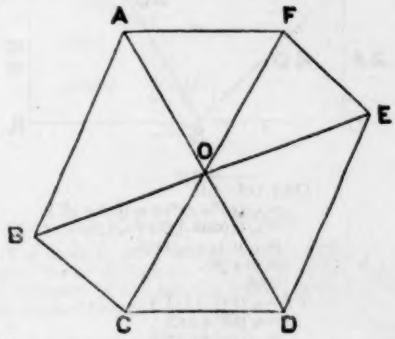
Because AF is ‖ to CD, and FC meets them,

$\therefore$ $\angle AFC = \angle FCD$.

Also $\angle FAD = \angle ADC$ (I. 29). And AF, CD (Hyp.).

$\therefore$ In the two $\triangle$s OAF, OCD, the two $\angle$s OAF, OFA = the two $\angle$s OCD, ODC, and one side AF = one side CD.

$\therefore$ $\triangle$s OAF, OCD are equal, and FO = OC, and AO = OD, *i.e.*, AD, FC are each bisected at the point O.



In like manner it may be shown that BE and AD bisect each other.

Wherefore, if a six-sided plane rectilineal figure, etc.

Q. E. D.

Algebra.

1. Divide $14xy - 21yz + 7ay + 6bx - 9bz + 3ab$ by $7y + 3b$, and find the square of $(2x - 3z + a)$.

$$
\begin{array}{l}
7y+3b)14xy-21yz+7ay+6bx-9bz+3ab(2x-3z+a \\
\quad 14xy+6bx \\
\quad\quad -21yz-9bz \\
\quad\quad -21yz-9bz \\
\quad\quad\quad 7ay+3ab \\
\quad\quad\quad 7ay+3ab
\end{array}
$$

$$
\begin{aligned}
&(2x-3z+a)^2 \\
&=(2x-3z)^2+2a(2x-3z)+a^2 \\
&=4x^2-12xz+9z^2+4ax-6az+a^2. \text{ Ans.}
\end{aligned}
$$

2. Find the quotient of

$$
\begin{aligned}
&\frac{5a^3-5ax^2}{6bc^2-6bx^2} \div \frac{a^2-ax}{bc+bx} \\
&\frac{5a^3-5ax^2}{6bc^2-6bx^2} \div \frac{a^2-ax}{bc+bx} \\
&=\frac{5a(a+x)(a-x)}{6b(c-x)(c+x)} \times \frac{b(c+x)}{a(a-x)} \\
&=\frac{5(a+x)}{6(c-x)}
\end{aligned}
$$

3. In a garrison containing 2,600 men the cavalry are one-third as many as the artillery, and one-ninth as many as the infantry. Find the numbers of each.

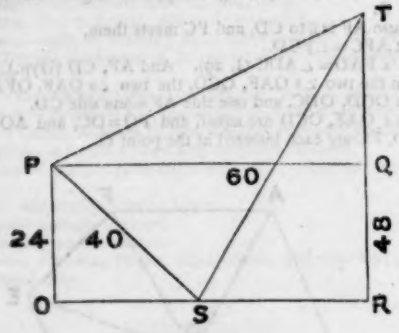
Let x = No. of cavalry,
then $3x$ = artillery,
and $9x$ = infantry.

$$
\begin{aligned}
x+3x+9x&=2600 \\
13x&=2600 \\
x&=200 \text{ cavalry} \\
200\times 3&=600 \text{ artillery} \\
200\times 9&=1800 \text{ infantry}
\end{aligned}
\Bigg\} \text{ Ans.}
$$

Mensuration.

The string of a kite caught on the top of a telegraph pole and the eaves of a house directly opposite. The height of the former was 24 feet and the latter 48 feet, while the distance from a per-

son standing in the road was 40 feet and 60 feet respectively. What was the length of the string caught?



$$OR = OS + SR.$$
$$= \sqrt{(40^2 - 24^2)} + \sqrt{(60^2 - 48^2)}$$
$$= \sqrt{(1600 - 576)} + \sqrt{(3600 \quad 2304)}$$
$$= \sqrt{1024} + \sqrt{1296}$$
$$= 32 + 36$$
$$= 68.$$
$$PT = \sqrt{(PQ^2 + QT^2)}$$
$$= \sqrt{(68^2 + 24^2)}$$
$$= \sqrt{(4624 + 576)}$$
$$= \underline{72{\cdot}11 \text{ ft. Ans.}}$$

Arithmetic.

FEMALES.

1. Simplify $\frac{3\frac{1}{7} - \frac{2}{3}}{\frac{4}{9} \times 7\frac{1}{12}}$; and divide ·00036 by ·006. Give the answer of the last part both as a decimal and a vulgar fraction.

$$= \left(\frac{66 - 14}{21}\right) \times \frac{4}{9} \times \frac{12}{61}$$
$$= \frac{52}{61} \times \frac{4}{3} \times \frac{12}{61}$$
$$= \underline{4. \text{ Ans.}}$$

·006)·00036
·06. Ans.

$\cdot 06 = \frac{6}{100} = \underline{\frac{3}{50}}$. Ans.

2. Add together $\frac{2}{3}$ of a guinea, $\frac{1}{4}$ of £1 6s. 4d., and $\frac{1}{8}$ of 3s. 8d. How many times the sum will amount to 6s. 8d.?

	s.	d.
$\frac{2}{3}$ gui. $= \frac{2}{3} \times \frac{21}{1} = \frac{14}{1}$	= 4	8
$\frac{1}{4}$ of £1 6s. 4d.	= 3	9½
$\frac{1}{8}$ of 3s. 8d.	=	8½
	9	1⅔. Ans.

$$\frac{6s.\ 8d.}{9s.\ 1\frac{2}{3}d.} = \frac{80}{109} \times \frac{3}{2} \times \frac{3}{11} = \underline{\frac{120}{121}}. \text{ Ans.}$$

3. Find how often 3·6 shillings is contained in £12·146.

$$= \frac{12146 - 1214}{900} \times \frac{20}{1} \div \frac{36 - 3}{9}$$
$$= \frac{10932}{900} \times \frac{20}{1} \times \frac{9}{33}$$
$$= \underline{66{\cdot}2\dot{4}. \text{ Ans.}}$$

4. Give the rule for converting a circulating decimal into a vulgar fraction. How much less than 1 is ·9̇?

If the decimal be a pure circulator write to the end of the first period for a numerator, and as many 9's as there are figures circulating for the denominator. If not, write to the end of the first period for the numerator, subtracting all figures which do not circulate, and for the denominator as many 9's as there are circulating figures, followed by as many o's as there are figures which do not circulate.

·9̇ is practically the same as 1, for although ·9 is ·1 less than 1, ·99 is ·01 and ·999 is ·001, and the more 9's there are the less is the difference.

Grammar.

MALES AND FEMALES.

1. If a spot on earth *be found*
Where, responsive to the alluring
Voice of nature—*to beguiling*,
Grief will cease *to be enduring*;
Then that spot must be *for ever*
In fair, beautiful Hardanger.

Analyse the above passage, parsing the words in italics.

Sentence.	Kind of Sent.	Connective.	Subj.	Predicate.	Object.	Extension.
(*a*) If a spot on earth be found.	Adv. cond. to *c*.	If	a spot	be found		on earth (place)
(*b*) Where, responsive to the alluring voice of nature so beguiling, grief will cease to be enduring.	Adj. to *spot* in *a*.	Where	grief responsive to the alluring voice of nature so beguiling	will cease	to be enduring.	
(*c*) Then that spot must be for ever in fair beautiful Hardanger.	P. S.		that spot	must be in fair beautiful Hardanger		for ever (time).

Be—aux. verb to *found*, indg. passive voice.
found—past part. of *to find*, refg. to *spot*.
be found—irreg. trans. verb, pass. voice, subj. mood, pres., 3rd, sing., agreeing with *spot*.
where—cop. conj., joining the sents. 'If a spot be found, and 'grief will cease.'
responsive—adj. of quality, qualg. *grief*.
so—adv. of degree, qualg. *beguiling*.
beguiling—partl. adj. of qual., qualg. *voice*.
to be—aux. verb to *enduring*.
enduring—pres. part. of *to endure*, rel. to *grief*.
to be enduring—reg. trans. verb, act., inf., pres., pres. prog. governed by *cease*.
for—prep., showing rel. between *cease* and *ever*.
ever—adv. used as a noun, neut., sing., obj., gov. by *for*.

[Note.—For ever = for *time* ever *continuing*. If the ellipsis be supplied thus, *for* would govern *time*, and *ever* qualify *continuing*]

2. Paraphrase the above passage.

If in the whole wide world there is a place so beautiful that its charms would successfully assail the grief-stricken heart, and drive away the sorrow, then such a spot can most assuredly be found on the beautiful Hardanger.

3. What are the principal methods of distinguishing words of Saxon or English origin? Give examples as far as possible from the above passage.

(1) The parts of speech most commonly used (excepting many nouns and verbs), as, adjectives of quantity, numeral adjectives, distinguishing adjectives, pronouns, auxiliary verbs, prepositions, conjunctions, interjections, and primary adverbs.

Ex.:—A, the, that, fair, be, much, will; on, to, of, off, in; if, where; ever, then.

(2) Words formed by modification, as irregular verbs, nouns forming their plural by a change of vowel, many primary derivatives and their roots.

Ex.:—Found.

Many common prefixes and suffixes.

Ex.:—*Be* in *beguiling*.

Most words of one syllable.

Ex.:—All except *grief*, *voice*.

Most of the nouns, verbs, and adjectives of common use.

Ex.:—*Grief*, *voice*, *beautiful*, *Hardanger* are not E.

Most words beginning with *kn*, *gn*, *wh*, *sh*, *th*, *gl*.

Ex.:—Then, where.

4. Name the common English prefixes.

A, an, at, after, all, be, e, en, for, fore, forth, gain, ill, in, mid, n, off, on, out, over, through, twi, under, up, well, with.

Geography.

1. Draw a map of the Ganges, or the Nile, or the Congo basin.

2. Describe Japan.

Japan consists of four large islands and a number of smaller ones, which stretch in a chain about 1,000 miles in length from Kamtschatka and Saghalien to Corea along the East coast of Asia, enclosing the Japan Sea. The chief islands are Yesso, Niphon, Sikok, and Kiu-Siu, and the total area is about 155,000 square miles. The Kurile Is. and the Loo Choo Is. also form part of the country. The surface is very mountainous, the whole range being traversed by a range of mountains from north to south, many of the peaks being active volcanoes, that of Fusiyama rising to a height of 14,000 feet. The rivers are short and rapid, the coast is indented, and has many good harbours. The soil is fertile, and the hills are rich in minerals, gold, silver, iron, and sulphur being abundant. Yesso is covered with forests, but in the other islands the timber has been cleared, owing to the density of the population. The chief forest trees are oak, beech, chestnut, maple, pine, and cypress, but there are other remarkable trees, among which may be mentioned the *wax-tree*, *varnish-tree*, and *camphor-tree*. The population amounts to 35,000,000, engaged in agriculture, cotton, and silk weaving, japanning, and the manufacture of porcelain. The chief towns are Tokio, Yokohama, Kioto, Osaka, Mangasaki, Kagosima.

3. Describe the character of our South African possessions.

The British possessions in South Africa occupy the whole of the south portion of that continent, from Cape Frio on the west to the river Limpopo on the east, and include Cape Colony, Natal, Basutoland, Griqualand West, Namaqualand, Damaraland, Zululand, and Kaffraria. The coast, which includes many harbours and bays, is about 1,500 miles in length. The surface rises from the coast to high lands in the interior. Several ranges of mountains run parallel with the coast, the highest being the Nieuveldt and Sneeuw Bergen range. The colonies are only ill-watered, owingto the irregular and scanty rains, and the rivers are not navigable to any extent. The Orange River, formed by the union of the Nu Gariep and Vaal, is the largest, and is about 1,000 miles in length. It forms the northern boundary of the colony. Other rivers are the Oliphant, Breede, Gauritz, Gamtoos, and Great Fish River. The climate is warmer than that of England, but is healthy. Gold, diamonds, coal, and copper are found in abundance. The specimens of heath are very numerous, and there are innumerable species of geraniums, iris, gladiola, and orchids.

SECOND PAPER.

Two hours and a half allowed.

Needlework.

FEMALES.

(One hour is allowed for the exercise in needlework.)

Arithmetic.

MALES.

1. A tradesman buys books 13 for 12, and at a discount of 30 per cent. off marked price. He retails them at a discount of 3d. in the shilling. Find his gain per cent.

30 per cent. off 1s. = 100 : 70 :: 1s. : $8\frac{4}{10}$d.

$12 \times 8\frac{4}{10} = 100\frac{8}{10}$ price paid for 13 books.

Price received for 13 books $= 9 \times 13 = 117$d.

Gain $= 117 - 100\frac{8}{10} = 16\frac{1}{5}$d.

Gain per cent. $= 100\frac{8}{10} : 100 :: 16\frac{1}{5} : \underline{16\frac{1}{4}}$. Ans.

2. How many pounds-worth of tea did I buy if by selling it at a profit of $16\frac{1}{2}$ per cent. I make £21 more than if I sell it at $15\frac{3}{4}$ per cent.?

By purchasing £100 worth he would gain $£16\frac{1}{2} - £15\frac{3}{4} = £\frac{3}{4}$.

To gain £21, therefore, he would require to purchase

$£\frac{3}{4} : £21 :: £100 : \underline{£2,800}$. Ans.

3. Divide £317 among three brothers in the proportion of $\frac{1}{2}, \frac{1}{3}, \frac{1}{4}$.

$\frac{1}{2}, \frac{1}{3}, \frac{1}{4}$

$= 4, 2, 1$

$\frac{4}{7}$ of $\frac{317}{1} = \frac{1268}{7} = \underline{£181\ 2s.\ 10\frac{2}{7}d.}$

$\frac{2}{7}$ of $\frac{317}{1} = \frac{634}{7} = \underline{£90\ 11s.\ 5\frac{1}{7}d.}$

$\frac{1}{7}$ of $\frac{317}{1} = \frac{317}{7} = \underline{£45\ 5s.\ 8\frac{4}{7}d.}$

4. Find the square root of 6407522209 and of $\frac{4}{5}$.

6407522209 (80047. Ans.

64

16004)075222

64016

160087) 1120609

1120609

$\frac{4}{5} = .8$

·8000000(·8944... Ans.

64

169) 1600

1521

1784) 7900

7136

17884) 76400

71536

4864.

History.

MALES AND FEMALES.

1. Give dates to the following events:—Trial of the Seven Bishops; Battle of Aghrim; Treaty of Paris; Battle of the Nile; Invention of the spinning-frame; Repeal of the Corn Laws; Indian Mutiny.

	A.D.
Trial of the Seven Bishops	1688
Battle of Aghrim	1691
Treaty of Paris	1763
Battle of the Nile...	1798
Invention of the Spinning Frame ..	1768
Repeal of the Corn Laws	1846
Indian Mutiny	1857.

2. Give some account of the government of James II.

One of James's first acts was to break his word. He promised to respect the laws, and immediately attempted to abolish the laws which excluded Roman Catholics out of office and Parliament. He dismissed all the judges and officers of State who did not favour his schemes, and then by the advice of his Roman Catholic counsellors he made a Roman Catholic Dean of Christchurch and a Roman Catholic President of Magdalen College. As he failed in securing the allegiance of the Tory party, he turned to the Protestant dissenters, and issued a *Declaration of Indulgence*, suspending all penal laws against them and dispensing with religious tests. He then dissolved the Parliament, but in endeavouring to influence the elections, he was everywhere resisted. In 1688 he issued a second declaration, which he ordered to be read in all churches. Against this order seven bishops petitioned, for which they were summoned to the King's Bench. The trial ended in a verdict of acquittal. The rejoicing of the soldiers at the result was such as to cause James considerable uneasiness The birth of his son hastened the downfall of James, for the Protestant malcontents now invited William of Orange to come to the country. When he found that invasion was intended, he tried to conciliate the people by restoring the charter of the City of London, by undoing the mischief at Magdalen College, by abolishing the ecclesiastical commission, and by replacing the lords-lieutenant whom he had dismissed. It was, however, too late. William landed, the people assisted him, and James fled.

3. Name some of the notable men in literature and art who flourished in the reign of George III.

Among the most famous were Dr. Johnson, the dictionary compiler and essayist; Garrick, a famous actor; Boswell, Johnson's biographer; Horace Walpole; Oliver Goldsmith, poet and novelist; the writer of the 'Letters of Junius'; Adam Smith, the author of the 'Wealth of Nations'; William Robertson, the Scotch historian; Edward Gibbon, the author of 'The Decline and Fall of the Roman Empire; Brinsley Sheridan, whose 'School for Scandal' is still popular; William Cowper, the poet; Robert Burns, the song-writer of Scotland; Robert Southey, Samuel Taylor Coleridge, and William Wordsworth, the lake poets; Thomas Campbell, Sir Walter Scott, Lord Byron, Percy Bysshe Shelley, Maud Edgeworth, and Jane Austin, all familiar names. In art, Sir Joshua Reynolds, Richard Wilson, Thomas Gainsborough, Benjamin West, Sir David Wilkie, and Joseph Turner, are famous; Thomas Bewick, as a wood-engraver, and Flaxman as a sculptor.

Teaching.

Write Notes of a Lesson on 'The Bear' for Standards I.-III.

I. *Description.*—Exhibit pictures of bears (white, black, and brown), and let the children compare them. Get answers also, containing further particulars if possible, from those who have seen live bears. From pictures, etc., learn—bear is a quadruped; three kinds, white largest, black smallest, heavy body, thick legs, long hair, strong paws, with five toes; five to ten feet long; teeth like men's.

II. *Habits and food, and locality where found.*—*White* found in Arctic regions, hence food such as found there: seals, fish, seaweed; food caught by itself; walks on ice; feet covered with hair (why?) *Black* in America and India; vegetables and honey; *Brown* in Germany and other central countries of Europe; lives on flesh and vegetables. Disposition—surly, solitary, fierce, sagacious, fond of young. Sleeps during winter, like? (dormouse, squirrel, etc.) Hungry and angry in spring; then dangerous. Does not attack man at other times, unless molested. Can be taught. if caught young.

III. *Capture and uses.*—Very valuable animal, so captured. Tracked by dogs; shot or speared. Fur in great request; black the best, made into rugs, caps, and clothing *Fat* made into bear's grease. *Hide* makes good leather; *flesh*, eaten.

Method.—Illustrate habits, etc., by stories where possible. Danger of hunting—story of Nelson; affection for young—mother carrying her cubs before her; savageness, preying upon sheep and cattle in David's flocks, etc.

Music.

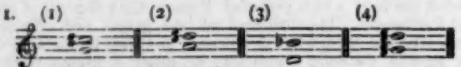
OLD NOTATION.

A quarter of an hour allowed for this paper.

(N.B.—Pupil Teachers may answer the questions in either the Staff Notation or the Tonic Sol-fa, but *not both*. The questions in the Tonic Sol-fa Notation will be found at the end.)

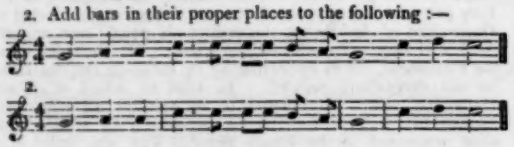
1. Write below each of the following intervals its name:—

1. (1) (2) (3) (4)



Augmented or Pluperfect 4th. Augmented or Pluperfect 4th. Minor 6th. Perfect 5th.

2. Add bars in their proper places to the following:—



2.

3. Explain, briefly, the following musical terms, and give the signs used to indicate the terms:—(1) *Fortissimo*; (2) *Pianissimo*: (3) *Crescendo*; (4) *Diminuendo.*

3. (1) *Fortissimo*—very loud, *ff*; (2) *Pianissimo*—very soft, *pp*; (3) *Crescendo*—getting gradually louder, *cres.* or ; (4) *Diminuendo*—getting gradually softer, *dim.* or .

TONIC SOL-FA NOTATION.

1. Write perfect 4ths above:—(1) *soh*; (2) *re*; (3) *ma*; (4) *lah.*

1. (1) *doh*^{1}; (2) *se*; (3) *lah*; (4) *ray.*

2. Explain, briefly, the following musical terms, and the signs used to indicate the terms:—(1) *Fortissimo*; (2) *Pianissimo*; (3) *Crescendo*; (4) *Diminuendo.*

2. (1) *Fortissimo*—very loud, *ff*; (2) *Pianissimo*—very soft, *pp*; (3) *Crescendo*—getting gradually louder, *cres.* or ; (4) *Diminuendo*—getting gradually softer, *dim.* or

3. Re-write the following in two-pulse measure:—

|d :- :d |n :- :n |s :- :s |d' :- :- |s :n :d |d :- :- ‖

3. |d ,,d :n ,,n |s ,,s :d' |s ,n ,d :d ‖

Owing to the great pressure on our space, we are reluctantly compelled to hold over the Fourth Year's Papers.

Publications Reviewed.

A Practical Arithmetic. By John Jackson, Principal, Commercial and Grammar School, Belfast. London: Blackie and Son.

To do this work justice we must constantly keep in mind its title, and remember that the work is not intended to be used without a teacher. In the preface we read, 'Its aim is essentially *practical*, and the endeavour has been to supply teachers with suggestions and illustrations rather than with full explanations of the various rules and methods enunciated.'

In the introduction we read the somewhat startling announcement that 'the First Four Rules are in the work practically reduced to three,' the meaning of which is that subtraction is taught as the converse of addition—*e.g.*, to take away 5 from 13, the pupil is taught to say, '5 and what make 13?'—the answer to which question is, of course, the difference required. Mr. Jackson claims for himself the merit of having discovered this; but surely every infant teacher almost in the land would tell us that very young children almost invariably perform their subtraction in this way—that is, by counting from the smaller number, and probably marking on the slate the ones he has to go through before arriving at the larger. Though we are assured that this method dispenses with all needless processes, yet we still find the old plan of borrowing and carrying resorted to; we are, therefore, bound to add that we can neither see any great advantage in its adoption, and are also obliged to deny its claim to originality.

Though Mr. Jackson in G.C.M. very properly teaches his pupils to discard all factors that are not common to the two numbers, and so reduce the quantity of figures to be written down, he here, as in long division, recommends the non-writing of the product of the divisor and each figure of the quotient. We very much doubt the wisdom of this; to say nothing of the comparative accuracy of the two modes, we feel convinced that many children would actually lose time by adopting the contracted method.

All that is said about short methods in performing multiplications, under certain circumstances, is most admirable, though capable of great extension.

Mr. Jackson disappointed us sadly on page 72, with the heading, 'Proofs of Divisibility,' though, perhaps, we had no right, after his preface, to expect any proofs whatever. What he meant to put was 'tests,' there not being one word of 'proof.' If the teacher can supplement the tests with their proofs, well and good; but a good many, unfortunately, cannot, and the number of them that could prove to the class the fact that the prime number 7 must divide 111,111 (7−1 ones)—a test given—without remainder, is very small.

In vulgar fractions there is a most admirable series of methods in addition, which we earnestly recommend to all teachers to study most carefully, as we quite agree with the author that when pupils are encouraged to analyse quantities to be operated upon, in the way here suggested, great interest is engendered, and real mental work encouraged.

In the reduction of recurring decimals to vulgar fractions, Mr. Jackson has broken through his plan, and given the algebraical proof for the rule.

In the applications of proportion, and in proportion itself, we entirely disagree with the author where the former are all solved by unexplained formulæ—the most wearying of all ways of learning arithmetic—the latter being entirely done in a mechanical way by the method generally known as 'fractional.' This fact alone, we fear, will necessarily exclude the book as a class-book from all schools under Government inspection, where the authorities, wisely or unwisely, will have the unitary method taught.

In addition to the usual subjects found in an Arithmetic, we have here chapters and examples on logarithms, invoices and commercial accounts, and some useful exercises in mental arithmetic.

As a collection of examples, the book deserves all praise.

Being issued by Messrs. Blackie, we need scarcely add that it is beautifully printed and strongly bound.

Philip's Grammar School Atlas: No. 3, for Senior Classes. G. Philip and Son.

This is a well-bound volume of seventy-five maps, about seven inches by five. It is called a Grammar School Atlas for Senior Classes. We should have thought it scarcely full enough for such pupils. The maps are exceedingly well done. The names are clearly printed, the colours neat and effective. Those who studied the educational section of last year's Exhibition remember what a remarkable feature of the French display was the excellence of the maps, and how much their appearance gained by the delicacy and good taste of the colouring. The plan of having a separate map of a country for different aspects of it is certainly good. We have eight maps of England, dealing with its physical features, its political divisions, its railways, etc. We cannot but think, however, that the size of the maps is small. North America is on a scale of 1,200 miles to the inch, and the United States more than 600 miles to the inch. This implies crowding the names or omitting them. The latter evil is the least, and it has been chosen. The map of Switzerland contains only about fourteen names of towns. Boys will almost certainly see many others in their reading which they will not be able to find in the map. This should not be. An atlas for elder scholars must contain the main physical facts and the chief divisions and towns. These can be printed in a bold type: but a boy uses his atlas somewhat as a work of reference. Hence it should contain more names than he is expected to learn by heart. We have lately been reading the 'Letters to Guy' and Stanley's new book. It is proper to say that on referring to some of the places named in these books we found the atlas quite up to date, and that is great praise.

Our Dwellings, Healthy and Unhealthy. C. M. Buckton. Longmans, Green and Co.

We have here fourteen addresses by a lady to the girls attending the Leeds Board Schools. They are now collected and published with thirty-nine excellent illustrations. We give the subjects of the first five chapters:—(1) Description of the model of a healthy working-man's dwelling; (2) plan of a healthy dwelling; (3) wall decoration and colouring; (4) ventilation; (5) drain pipes and traps.

The information contained in this volume is valuable. Much of it is, in our opinion, above the capacity of girls in ordinary board-schools, especially the part of the book which deals with structural and architectural matters. Poor people cannot alter the shape of the flues, or even pull up the floors and examine the drain-pipes. This sort of sanitary engineering should be done by the public authority. It is supposed to be done. But in London at least it is done very badly. Only this year a new house was hired not far from Clapham Junction. The tenant thought he would like to have a small conservatory put up. While digging out the foundations it was found that gravel had been removed, and refuse used to fill the hole. This might have remained there till some of the family had died of fever, and even then the cause might not have been discovered. Such wickedness ought to be punished most severely.

We think, however, that many of these questions are hardly suitable for school girls. The author evidently wishes to be quite up to the present state of knowledge. In this laudable desire there is a danger of going too fast. We are told on page 69 that a doctor has discovered that cholera is caused by a poisonous living creature, called a 'germ,' so small that it can only be seen by the most powerful microscopes. The author would perhaps be surprised to hear that another doctor is prepared to swallow as many of those dreadful creatures as she likes to send him. The cause of cholera is not disposed of quite so easily as is here implied. The moral that water should be boiled before it is drunk, unless it is known to be pure, is excellent. The advice would have been quite as valuable if stated dogmatically, and not supported by what may be false, and certainly is not yet proved to be true. Girls in board schools are not likely to buy this book and read it. But it will have a good circulation, and deserves it, and those who study it will be well repaid.

French Examination Papers in Miscellaneous Grammar and Idioms. By A. M. M. Stedman, M.A. George Bell and Sons.

Mr. Stedman only claims for his little volume that he has here collected a number of questions and exercises which teachers will find useful. There is no doubt that such a volume as this—carefully put together, and calculated to help a teacher in finding out what students do, rather than what, as most examination papers, they do *not* know—will be of the utmost service. The questions, Mr. Stedman tells us, have been 'graduated in difficulty, and in some cases the questions have been repeated.' This seems to us an excellent arrangement; repetition is absolutely necessary, and it is far pleasanter to find certain important questions repeated from time to time than to be obliged to go back and over all the often unnecessary exercises. We are sure this book will be popular. We ourselves shall assuredly use it in teaching.

Common-Sense French. Second Part. By H. Pooley and K. Carnie. Swan Sonnenschein and Co.

In opening this book we felt some fear. We expected another of the many useless works that undertake to 'teach French pronunciation without the help of a master.' But we were agreeably surprised. The rules for pronunciation, etc., that are given do not belie the title of the work; they are full of common sense and practical utility—and they are this because they only aim at helping the teacher by providing him with reading exercises and examples that he cannot always find ready to hand. We only wish French teachers, or rather teachers of French in schools, would take to heart the advice given by Messrs. Pooley and Carnie, and carry out their excellent suggestions. We have but one fault to find with a book that will be found especially useful in class-teaching—that some of the extracts were not more interesting. Many of the books or verses quoted are charming—who could ever tire of La Fontaine?—but many others are silly to a degree. We heartily endorse the author's words, that 'there is no better or more rapid way of becoming familiar with forms of expression, idioms, etc., than by committing poetry [we should like to add prose] to memory.' This is true—but the poetry or prose learnt by heart should be worth learning. On the whole, however, we can heartily commend this book.

Handbook of Translation: Latin. Edward Stanford.

This handbook, we are told in the preface, has already gone through four editions—a fact which sufficiently proves that it has met a real educational need. The practice of setting passages out of books not previously mentioned has come more and more into favour. Candidates and teachers cannot afford to disregard it. And why should they? The change has been brought about by those who ought to know what is best, and why should their suggestions not be adopted?

We have here two hundred passages, alternately poetry and prose, of about half a page in length. There is an index of authors, giving the exact references, so that the student can at once turn to the context of the passage if he wishes to do so. This is a very useful feature. Passages are taken from Cæsar, Virgil, Ovid, Horace, Livy, Pliny, Propertius, Lucan, Sallust, Tacitus, Martial Statius, Catullus, Juvenal, Seneca, Phædrus, Lucretius, Persius, Terence, Tibullus, Plautus, Suetonius, and

Claudian. Most of them, of course, are taken from the works of a few of the greatest names in the list. It is plain, however, that a great variety of language and style has been provided.

A book of this sort that has reached a fourth edition is scarcely in need of praise. The favour it has met with is a guarantee that the passages have been judiciously chosen, and likely to be found of real service to those who are sufficiently advanced to read a classical author at sight, or with a little help from a grammar and dictionary.

French Course. Second Year. A. J. Dubourg. W. and R. Chambers.

We are afraid that the number of 'French Courses' is growing too fast. Monopoly, no doubt, nearly always has a very bad effect. The history of the 'Public School Latin Primer' is not encouraging. We must not, however, forget that boys go from school to school, and the drawback of having to use new books is considerable. It is always considerable, though by no means equally so. If every professor, as soon as he is appointed to an important post, or is elected as an examiner, issues a new set of instruction-books, there will be serious cause for complaint. It is a matter which might fairly be commended to the attention of the Société Nationale des Professeurs de Frangais when they meet for their next annual conference.

The little book before us contains about two hundred pages. It is printed and bound admirably, as all books are which are issued by Messrs. W. and R. Chambers, whose motto seems to be 'Excellence and Economy.' The 'Second Year' is a continuation of the first. It begins at Lesson 68, and carries the pupil through irregular verbs of the four conjugations and the principal rules of syntax. There are ten pages of conversations in French, freely translated, and vocabularies from French into English and English into French. We suppose there will be a 'Third Year. The syntax is by no means complete in the 'Second Year,' even in regard to some important rules about the use of the articles.

A Complete Arithmetic, with Answers. Nelson and Sons.

This Arithmetic forms one of the Royal School Series, so deservedly well known in England and the colonies. The way in which it is got up leaves nothing to be desired.

The book is intended for general use. It is said to be suitable for elementary classes in primary and secondary schools, and to contain all that is required in the pupil-teacher's course. There is an abundance of examples. There might have been more of what are known as problems, especially in the compound rules and reduction. Teachers will want many more and much harder ones than are found here. We have carefully examined the chapter on fractions. After doing so, we are satisfied that a class using this book ought to have a good teacher. There is no reference at all to diagrams, which are always helpful, and sometimes necessary, in order to make dull children see the reasons for the rules. We are disappointed at not finding an explanation of the extended meaning which the word 'multiplication' receives in fractional arithmetic. There is no reference made to it. And yet, as every teacher knows, one of the commonest difficulties which a boy meets with when he begins to learn fractions is how $\frac{1}{2}$ multiplied by $\frac{1}{2}$ should be no more than $\frac{1}{4}$. We naturally turned to see how the word 'multiplication' was defined in the early part of the book. What do we find? 'Multiplication is a shorter method than addition of arriving at the same result.' How utterly unsatisfactory this is! If all a boy is to be told about multiplication is that it is a shorter method than addition of arriving at the same result, he might well wonder why he should ever use the method of addition at all. It is quite easy to tell a boy what 'this shorter method' really is, and how the meaning of the word is extended when we come to deal with fractions. The pupil who learns the so-called definition we have quoted has not learned what multiplication is, and he must unlearn what he thinks he knows before he can go on with advantage. With what delight one turns to De Morgan's Arithmetic! What an advantage it would be to the scholars if their teachers would study that book again and again!

The printer and publisher have done their work better than the author. In the hands of able teachers it may supply all that is necessary. To say that it is suitable for pupil-teachers would be misleading. It would not enable them to do their own work, and, what is far more important, it would not enable them to explain the subject to their classes. We are greatly disappointed that the volume is not more worthy of a place among its excellent 'Royal' fellows.

Then and Now. The Cathedral Cave. London: Hodder and Stoughton.

'Then and Now,' 'The Cathedral Cave,' are the titles of two little books, got up in the most charming style, and printed on thick paper. They are a shilling each. One wonders how they can be sold at the price.

'Then and Now' is a temperance tale. A young farmer, with hereditary tendency to drink, takes the pledge under the kindly influence of the clergyman's wife, which he kept for eleven years. How he came to break it we will leave our readers to discover for themselves. The history of his temptation and the sorrow it brought are told with simplicity and force. The book would be a very suitable one to add to a village library.

'The Cathedral Cave' is a nice little tale for children. It is the history of six months spent at the seaside on the coast of Ireland. Poor Sam's sad, but perhaps happy, end is pathetic enough. The adventures of the children are interestingly told. It is really a child's book. The lessons taught in it are excellent. We could recommend it to any mother who wished to teach her child unselfishness and gentleness and purity. A copy should be found in every Sunday-library in the country.

Chambers's Graduated Primer: Parts I. and II. London and Edinburgh: W. and R. Chambers.

These primers, the one containing thirty-two and the other forty pages, form a capital introduction to the series of Graduated Readers which we have previously noticed in these columns. They have been very systematically written, and are equally adapted for teaching reading by the ordinary, or the 'look-and-say,' method. With one or two exceptions, the first part contains words with short vowels only, the use of the various consonants coming in in successive lessons. With the exception of those devoted to the alphabet and to revision lessons, there is a charming woodcut on every page, which illustrates in some form or other the new words used in the page. The second primer introduces the long vowels and diphthongs in such an easy, natural manner, that insensibly a child is made acquainted with new combinations, and his vocabulary is enlarged on a scientific basis.

The pages for revision contain all the words used in the previous four or five pages, and thus serve a very useful purpose without the same sentences being repeated. The primers are cheap, and are got up with great care and judgment.

Chambers's Advanced Reader. London and Edinburgh: W. and R. Chambers.

Although not named in the same way, this book is got up in the same style, and upon the same plan as the Graduated Readers published by this firm. It is a book of 320 pages, and includes numerous selections from standard authors, and some specially prepared lessons on several topics of interest at the present time. The selections are of a popular character, and are none of them of such difficulty as to be beyond the capacity of the highest classes in elementary schools, although the work has been prepared for higher schools as well. The poetical pieces have been well chosen, and when we name

'Ivry,' 'The Cloud,' 'Address to a Mummy,' and 'Quarrel of Brutus and Cassius' as among the number, it will at once be seen how varied is their character. The difficult words in each lesson are fully and carefully explained, and some twenty-five pages at the end of the book are devoted to a transcript of these difficult words, to prefixes and affixes, and the more common roots of English words. The book is a worthy continuation of a superior series of reading books.

Geographical Reading Books. Europe and America. Longmans and Co.

The aim and scope of geographical reading books are pretty well understood by teachers. Information is to be conveyed, but it is to be done in a pleasant way. Interest is to be excited, curiosity roused, and a love for reading cultivated. Maps and diagrams and illustrations are to add the attractiveness and usefulness of such volumes as are now to take the place of dry lists of names and figures.

The book before us is a very good specimen of what we have endeavoured to sketch. The work contains four large and well-executed maps; Europe (Physical), Europe (Political), North America, South America. There are forty-three lessons of about four pages each, every lesson being as a rule complete in itself. In the fourth we have an account of the Alps. Only the really important peaks, like Mont Blanc, Monte Rosa, and the Jungfrau, are mentioned. The snow and glaciers are then described, and also the most important lakes. Finally, we have an account of the passes and the tunnels. A teacher can add what he thinks proper. Notes may be given where the information seems too meagre.

The language is clear and precise. The names of the editor and writer are sufficient guarantee for the accuracy of the matter and for its judicious selection.

The illustrations are plentiful; one for every five pages. They are not very clear. This is a pity; the Scene in the high Alps, Geneva, Chalêt of an Alpine Herdman are exactly the sort of illustrations which should be found in geographical readers. On the other hand, there are just a few like that one on page 193 which are horrid in themselves and badly executed. We hope, for the sake of the children who will profit by reading this book, that these will be struck out in the next edition, and that the others may be made more bright and clear. The execution of the illustrations is certainly the weakest part of the book, which our readers will gather we have a high opinion of.

Chouans et Bleus. By P. Féval. With Notes by C. Sankey, M.A. Longmans and Co.

The editor of this French reading book has been engaged for fifteen years in teaching French. He does not, however, expect that his notes will please everybody. There is a wide divergence of opinion among even competent judges, as to what sort of help should be afforded. The author reminds us that few boys or girls have a Brachet at their elbows, and fewer still a Littré, and even if they had, they could not be trusted to use them. The book contains about one page of notes to five of text. The notes are very largely explanatory. Grammatical difficulties are, of course, referred to; the main drift of of them, however, seems to be to give such help as a junior student would want, before he could understand his author. We ought to mention that there is an excellent introduction of twenty-four pages, giving a most useful and instructive account of Brittany, the Revolution, and La Chouannerie. This will be of great value in enabling a boy to enter into the spirit of these stirring tales.

The type is beautifully clear and the binding all that could be desired. We recommend 'Chouans et Bleus' to those who want an easy, attractive, historical novel. They will certainly be pleased with Mr. Sankey's edition.

Workshop Appliances. By C. P. B. Shelley. Longmans and Co.

This is not a new book. It has already reached a sixth edition, which has been considerably enlarged and improved. It is scarcely now necessary to say, that the volume of Professor Shelley is one of the most valuable of the series of text-books of science. It has been from the first accepted as a complete guide to the subject; nor need the student want a better. The diagrams, which are a cardinal feature in a work of this sort, are excellent in every respect. No expense seems to have been spared to make them perfect.

Science classes are about to meet for the winter session; courses of science instruction will soon be commenced in all the large towns of the country. We cannot do better than call the attention of teachers and students to the work before us. For the sake of those who have not seen it, we append the headings of the chapters:—

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A Collection of Maps and Plans illustrating the Period from 1760 to 1810. London: Longmans, Green, and Co.

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Elementary Star Atlas. By Rev. J. H. Espen, B.A., F.R.A.S. London: Swan Sonnenschein and Co.

This series of twelve star maps is intended for the use of beginners with the astronomical telescope as well as naked-eye star-gazers. We cannot suggest a better investment for those who want guidance in amateur stellar observation.

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Many Reviews are unavoidably held over.

The 'Practical Teacher' Sale and Exchange Column.

Owing to numerous requests, we have been induced to start this Exchange Column for the benefit of our readers. We shall be glad to insert announcements relating to the 'Sale or Exchange' of books, etc., at the rate of One Penny per Line, *prepaid.*

Yorkshire books, pamphlets, pictures (or Y. printed books), purchased or in exchange for 'Haworth Past and Present,' 20 illus., 3s.
Idel Nonconformist and Airedale College. 10 illus., 3s.
Brighouse Independency. 4 illus., 3s.
Life of Captain Hodgson, 1640. 1s. 3d.
Wright's Halifax, 1884. 1s. 6d.
Nonconformist Register, 1640-1750. 6s.
Oliver Heywood's Diaries. 4 vols., 24s.
Halifax Families and Worthies. 6s.
Ilkley, Ancient and Modern. 10s. 6d., or 17s. 6d.
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